VOLUME 4 1928 NUMBER 2

ECONOMIC GEOGRAPHY

APRIL

CLARK UNIVERSITY, WORCESTER, MASSACHUSETTS, U.S.A.

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ECONOMIC GEOGRAPHY

Published Quarterly by

CLARK UNIVERSITY, at 10 Ferry Street, Concord, N. H.

Editorial Office: Clark University, Worcester, Massachusetts

PRICE $1.50 THE CURRENT NUMBER

FIVE DOLLARS A YEAR
(except to charter subscribers)

Entered as second class matter at the Post Office at Concord, N. H., under the Act of March 3, 1879.

THE AGE OF STEEL

NO country in the world is so lavishly endowed with resources as the United States—beneficent climate; favorable relief; fertile soil; adequate forests, grass land pastures, and rich crop lands; and great reserves of petroleum, iron, coal, copper, and almost all the minerals requisite to a great industry. Probably no other country possesses such adequate supplies of the raw materials necessary to the development of a great industry and the occupation of a great population in industrial labor, and also such adequate sources of food for feeding that population, of fibers for clothing it, of building materials for sheltering it, and of fuel and illuminants for heating and lighting its homes.

This fortunate combination of resources has led to an iron and steel industry which has become the greatest in the world and which bids fair to attain a size and importance not yet even approached. The rapid rise of the industry, its dominance in the markets of the world, and its contribution to the progress of the world and the comfort of the world's peoples constitute a romantic tale that has not yet been told, the majestic theme of this age about which the virile literature of our time has begun to center.

No civilization based solely on material things can stand; but when it is based upon the leisure and opportunity that material things provide, no one can say to what heights it may achieve. Surely the wealth in material resources to which the civilization of our age has attained should be the groundwork of a renaissance in art and music and literature and human culture to which the "glory that was Greece and the grandeur that was Rome" will not even "hold a candle." The sordid age of steel may well become transmuted into the golden age of culture!

ECONOMIC GEOGRAPHY

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THE IRON AND STEEL INDUSTRY OF THE PITTSBURGH DISTRICT[1]

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THE Pittsburgh District is the capital of the world of iron and steel. Comprising only a little more than Allegheny County (Fig. 1), this district produces annually more than one-fourth of the nation's steel. Other cities, to be sure, smelt iron and make steel, but no other is so thoroughly identified with every phase of the industry as is the city at the head of the Ohio. Thither from the Lake Superior Region come annually from 12,000,000 to 14,000,000 gross tons of iron ore (13,600,000 gross tons in 1925 or about one-fourth of the nation's total) to be smelted and converted into steel, and fashioned into air brakes, axles, bridges, car wheels, electrical machinery of all kinds, jacks, locomotives and cars, nails, plates, plumbing supplies, rails, railway signals and safety devices, structural forms for buildings, tin-plate, tubes and pipes, wire, and woven wire fencing. So intimately is Pittsburgh related to steel that most people never think of one without immediately thinking of the other; the two terms have become synonymous.

To appreciate the reasons for Pittsburgh's place in steel-making, it seems appropriate to delve very briefly into the history of Pennsylvania's iron and steel industry.

EVOLUTION OF THE IRON INDUSTRY IN PENNSYLVANIA

The iron industry in Pennsylvania goes back to the colonial period when in 1716 the settlers set up their primitive forges and began making such necessary articles as knives, plow points, and nails.

It passed through three stages, the first being the charcoal. During this period the industry was widely scattered, because the population was sparse and widely disseminated, and transportation facilities were practically nil. Centralization was out of the question even in this well-forested state, because no district could produce sufficient wood to supply its furnaces very long. Accordingly furnaces were moved or abandoned when the available forest became depleted.

Large-scale production of iron and steel and incidentally the second stage began with the introduction of anthracite coal as fuel about 1840. So long as furnaces were small, charcoal made an ideal fuel, for it made

[1] The writer wishes to express his appreciation of the assistance of Russell A. Dixon of the University of Pittsburgh with whom all the field work for this paper was done. Mr. Dixon also took most of the photographs.

FIGURE 1.—There is as yet no definite agreement as to just what is meant by the Pittsburgh District. J. I. Andrews, a witness in the Federal Trade Commission *vs.* The United States Steel Corporation, defined it as the area within a radius of 50 miles of Pittsburgh, including Wheeling on the west, Vandergrift on the north and Latrobe on the east. The Lake Superior Iron Ore Association defines the district as Pittsburgh and its satellite towns of Bessemer, Clairton, Donora, Etna, McKeesport, Midland, Monessen, Neville Island, Rankin, South Duquesne, and Woodlawn. Professors Ely and Rittman of Carnegie Institute of Technology in their study of "Power and Fuel Consumption of the Iron and Steel Industries of Pittsburgh" define the district as that within a radius of 30 miles from the Pittsburgh City and County Building. They claim that the people and the iron and steel plants comprised within this area are intimately associated with and largely dependent upon the facilities of corporate Pittsburgh. The corporate limits of the city long ago proved inadequate to hold the industries which now line the rivers and railways. They are much more restricted than those of most American metropolitan districts. As a result of field investigations extending over a period of several months during which time considerable attention was given to the delimiting of the area, the writer feels that the logical geographic limits coincide with those designated by Professors Ely and Rittman.

the purest iron. But large furnaces became a necessity with the coming of the railway and the factory. Anthracite, though by no means an ideal blast furnace fuel, replaced charcoal in 1856 and reigned supreme for nearly two decades.

Since the producing area was in northeastern Pennsylvania on the highlands between the Delaware, Schuylkill, and the Susquehanna valleys near iron ore, large markets, and excellent transportation facilities, it became our first great shipping field.

The third period, that of coke, came with the close of the Civil War, when coke from the Connellsville District—50 miles from Pittsburgh—began to replace anthracite, which at best had been an obstinate and inefficient fuel, since it was wasteful of draft, crushed under the burden of the ore, thus limiting the height of the furnace, was costly, lacked uniformity, and contained a high percentage of non-combustible, non-heating elements. Furthermore, its cleanliness and relative freedom from smoke made it an ideal domestic fuel and, added to its limited supply, put the price beyond the reach of blast furnace owners. The new fuel caused the iron industry to migrate immediately across the Appalachian barrier into the Ohio Basin where it has remained.

SIGNIFICANT ASPECTS OF IRON SMELTING

Iron ore must be smelted in a blast furnace (Fig. 2) for the removal of certain foreign elements. The blast furnace is a mammoth tower, provided with four hot blast stoves, into whose top iron ore, coke, and limestone are dumped. The materials are carried by electrically operated lorries to "skips" of which there is a pair to each furnace. A "skip" makes the trip in one minute with its average load of 7,000 pounds of ore, or 6,000 pounds of limestone, or 3,600 pounds of coke.

The limestone is used as a flux to "draw" the alumina, manganese, silicon, sulphur and other ingredients, except phosphorus, out of the

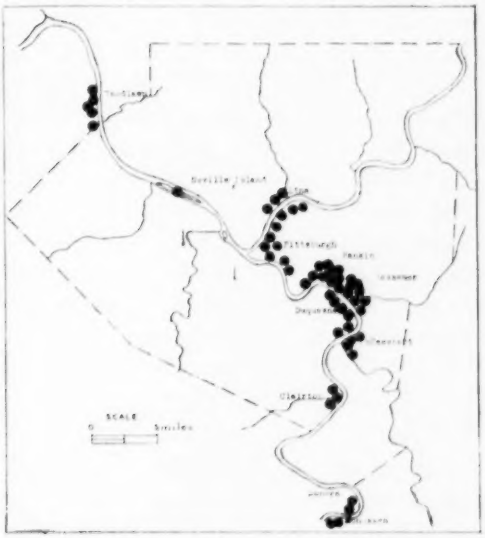

FIGURE 2.—The distribution of blast furnaces in the Pittsburgh District in 1925. With 56 furnaces, this region outnumbers by far any other in the United States. The two furnaces at Midland, 30 miles down the Ohio, could not be shown on this map.

melting iron; as a matter of fact some of these elements remain in the molten ore. The metallic iron falls to the bottom of the furnace and is drawn off at intervals to be cast into pigs or converted into steel.

The intense heat required in smelting is supplied by the coke which burns in a tremendous blast of heated air forced into the bottom of the furnace from the stoves.

To make a ton of pig iron requires 1 ton of coke, 1.9 tons of iron ore, and ½ ton of limestone. It is patent then, that in the Pittsburgh District which produces so huge a tonnage of pig iron and steel ingots (Fig. 3), that an almost incomprehensible tonnage of the raw materials must be transported to the mills. Accordingly, the economical assembling of these materials is one of the most Herculean tasks confronting the manufacturers. This phase of the industry, however, is treated in detail on pages 128 to 133 inclusive.

EVOLUTION OF THE STEEL INDUSTRY IN PENNSYLVANIA

As locomotives became larger and more complicated and trains became longer and heavier, iron rails and bridges failed to hold up. The situation became critical indeed, and better iron was demanded. But instead of making *better* iron, the manufacturers made Bessemer steel. Steel differs from iron in the proportion and accuracy in the mixture of the elements of which it is composed. It also wears better. In fact it is claimed that one of the new rails outwore twenty iron ones. Bessemer steel held the field for more than a third of a century, that is from 1864 to 1899, at which time it fell into bad repute, for it was not performing satisfactorily. It was then replaced in most instances by Open Hearth steel which dominates the field today.

SIGNIFICANT ASPECTS OF STEEL MAKING

Since iron in pigs has to be reheated during the steel-making process, thereby increasing the cost, most of Pittsburgh's iron is not converted into pigs, but is turned directly into steel.

The two most common processes are the Bessemer and the Open Hearth. Each is characterized by conditions which make it suitable to special uses. In the Bessemer process molten pig iron of low phosphorus content (made from ore containing less than 0.001 per cent of phosphorus per 1 per cent of iron) is poured into the Bessemer converter —a huge pear-shaped retort—and penetrated by a blast of hot air. The air combines with the carbon in the pig iron and passes out of it and

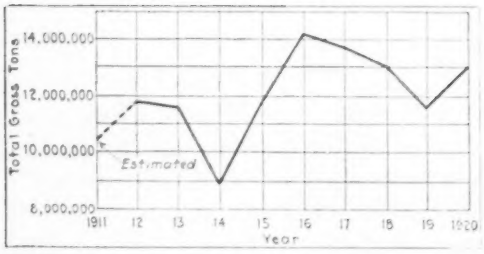

FIGURE 3.—Curve showing the total quantity of steel ingots produced per annum in all the steel works of the Pittsburgh District. (From "Power and Fuel Consumption of the Iron and Steel Industries of Pittsburgh," *The Blast Furnace and Steel Plant*, November, 1925.)

the retort in the form of spitting flaming sparks. When all the carbon is gone, a definite amount is restored. Steel made by this process depends to a considerable extent upon the qualities of the molten iron, for no changes may be made during the conversion. The production of Bessemer steel is decreasing because the supplies of high-grade Bessemer ore are dwindling rapidly and because the low quality of the steel lessens the demand for it.

In the Open Hearth process the undesired elements in the molten iron are burned out by playing a flame over the liquid metal in a great open hearth that resembles a baker's oven. In this process materials of greater variety including scrap and ores containing between 1 and 2 per cent of phosphorus are used. This method is costlier and slower, taking ordinarily from 8 to 12 hours instead of 10 or 15 minutes, but it has the advantage of making from 50 to 200 tons instead of 15. Exceedingly close control of the reactions may be exerted, and frequent tests of the metal in the bath may be made so that the content is definitely known and the product may be warranted. So important are these advantages that in the specifications for such high-grade construction as bridge building, where an exact relation between the working stresses and the strength of the materials is imperative, Open Hearth steel is indispensable.

The molten steel from either process is then cast into ingots weighing three to ten tons, which are "to steel what bar gold is to currency—the standard by which the production of steel is measured" (Table I).

The ingot then passes to the blooming or rolling mills where it is converted into the forms in which the steel reaches its markets. It probably starts at one end of the great mill and in less than an hour arrives at the other end in a different form, having been fashioned into a rail, rod, bar, or plate, or drawn into wire or perhaps even cut into nails. Every process is executed with a minimum of delay.

Both iron smelting and steel-making are carried on most economically in huge plants involving a great outlay of capital, well located with respect to iron ore, fuel, and limestone. The number of such plants

FIGURE 4.—Distribution of coal in Pennsylvania. This map shows Pittsburgh's ideal location in the heart of the bituminous fields of the Keystone State. In so far as fuel is concerned, no iron and steel center in the world has been in the past, is at the present, or will be in the future so advantageously located. M. Campbell of the United States Geological Survey estimates the reserve of bituminous coal shown here at 102,574,000,000 tons. (Map from the *Geography of Pennsylvania* by Z. A. Thralls, p. 9.)

obviously is restricted. Practically all of them are controlled by great corporations. In Pittsburgh the leading producers are the Carnegie Steel Company, a subsidiary of the United States Steel Corporation; the Jones and Laughlin Steel Corporation, the Crucible Steel Company; and the Pittsburgh Steel Company.

FIGURE 5.—The cliffs along the rivers in the Pittsburgh District are dotted with productive coal mines, which are worked assiduously to supply the numerous mills with fuel. Here we see barges on the Allegheny River being loaded with coal. The mine extends into the cliff at the left and the coal is brought directly to the waiting barges on the river to be conveyed cheaply to Pittsburgh's waterside plants or to cars on the tracks which follow its banks. In the past there was relatively little traffic on the Allegheny. However, a dam is being installed at Freeport, some 30 miles above the "Point," which is of great value in facilitating the movement of coal from the Freeport vein, which is mined more extensively now that transportation costs are falling.

CONCENTRATION OF THE INDUSTRY IN PITTSBURGH

Everyone knows that Pittsburgh is America's premier iron and steel center, but relatively few know the several reasons why. This paper purposes to emphasize the most significant factors contributing to and maintaining the district's prestige and to forecast the probable future.

LOCATION OF PITTSBURGH WITH REFERENCE TO FUEL

Pittsburgh's proximity and easy access to great resources of high-grade coal have been the decisive factors in making it the hearth of the nation. The city's tributary coal area is all of western Pennsylvania, though Allegheny, Washington, Westmoreland, and Fayette counties are the greatest producers. The last two produce about one-third of the bituminous coal of Pennsylvania and approximately one-ninth of the output of the whole country.

Coal

The coal is mined both near and away from the rivers. The most extensive mining development has taken place where the streams have cut down to or below the level of the bed or along the surface outcrops at the sides of downfolds. A trip up the valleys of the Monongahela and the Youghiogheny and to a less extent along those of the Ohio, the Conemaugh, and the Allegheny discloses numerous mines strung out along them (Fig. 5).

In the four counties named above the Pittsburgh Bed is the most important and has so overshadowed the others that they have been but little developed. This bed is celebrated for its wide extent, its great thickness (3½ to 11 feet), its excellence (contains 57 to 65 per cent fixed carbon, 30 to 35 per cent volatile matter, 4 to 14 per cent ash, and usually less than 1 per cent sulphur in Allegheny County), and its ease of mining (it lies almost horizontally and outcrops along the several valleys). In Allegheny and Westmoreland counties this bed is rapidly approaching exhaustion, though in Washington and Fayette counties it remains a great reserve for the future.

In the latter county the Fayette anticline divides the coal into two districts—the Connellsville and the River, the names designating their

geographic locations.[2] The former embraces an area about 25 miles long and 2½ miles wide comprising some 75 square miles, which has the reputation for making the standard coke of the world. The latter contains coal that is primarily of the gas type, though it is now being used advantageously for coke in by-product ovens.

Next to the Pittsburgh Bed in commercial importance is the Upper Freeport which is found widely distributed. It ranges from 2 to 10 feet in thickness. Freeport coal is friable and breaks out in large lumps. It averages about 33 per cent volatile matter, 56 per cent fixed carbon, 8 per cent ash, and 1.5 per cent sulphur. It is mined extensively only in Allegheny County, but with the exhaustion of the Pittsburgh Bed in western Pennsylvania, it will gradually assume a place of importance.

The Sewickley Bed, which varies from a few inches to 3½ feet in thickness, ranks third in importance, but as yet is not mined commercially.

The transportation facilities of the coal-producing area are excellent. All the streams and therefore all the railways focus on Pittsburgh, giving it a strategic commercial location. The Monongahela, the Allegheny, and the Ohio rivers all are navigable and great tonnages of coal move over them by barge. The coal-carrying railways have a down-grade into the city and an up-grade out of it. Thus outgoing freight consists primarily of supplies and manufactured commodities, while incoming freight consists essentially of fuel, iron ore, and limestone.

In summarizing, the bituminous coal reserve of western Pennsylvania is estimated to be about 102,574-000,000 tons.[3] This, of course, includes not only tonnages of coal that presumably can be extracted under present market conditions and mining methods, but also those reserves which can eventually be extracted under price levels permitting higher cost operations.

[2] Sisler, J. D., "Bituminous Coal Fields of Pennsylvania," *Part II, Topographic and Geologic Survey, Bulletin M6* (Harrisburg), 1926, p. 232.

Coke

Most of the coal used in the iron industry of this district must be converted into coke which makes an ideal blast furnace fuel because (1) it is strong enough to sustain without crushing the huge burden of 1,500 tons of the load in the furnace; (2) it is porous and thus permits the hot blast to permeate it freely; (3) it is pure (88 per cent carbon) and burns with very little ash.

Western Pennsylvania (Pittsburgh's tributary area) makes more coke than any other region or state. Both bee-hive and by-product ovens are in use.

In 1922 the 38,593 bee-hive ovens at Allegheny Mountain and Allegheny Valley, Connellsville, Lower Connellsville, Pittsburgh, and Upper Connellsville converted 10,416,729 tons of coal into 6,839,980 net tons of coke—a yield of about 65.6 per cent coke. This transformed fuel had a total value of $38,091,586 and a value of $5.57 per ton.

During the same year the 2,310 retort ovens at Glassport, Franklin, Rosedale, Clairton, Farrell, Dunbar, Pittsburgh, and Midland made 5,551,-408 net tons of coke from 8,118,-451 net tons of coal—a yield of about 68.4 per cent coke. This fuel had a value of $25,169,958 or $4.53 per ton.[4]

[3] Campbell, M., United States Geological Survey.

[4] Tryon, F. G., and Bennit, H. L., *Coke and By-Products in 1923.* United States Geological Survey, 1926, p. 443.

The first successful use of coke as blast furnace fuel was in 1859. Immediately thirty ovens were built in the Connellsville area. From that time until quite recently, most of the coke used in the Pittsburgh furnaces was roasted in the Connellsville District in bee-hive ovens (Fig. 6). As the coal comes from the mine it is placed into cars or lorries, which are hauled off along the top of the ovens. The coal is then dumped from the lorries into openings in the tops of the ovens. When these are full, the contents are evened off by a leveler and the door is sealed save for about an inch at the top. The whole operation of burning the volatile substances out of the coal except the carbon is regulated by the amount of air entering this aperture. The charge is left in the ovens 48 hours, except at week-ends, when to avoid Sunday work, it is left in for 72 hours. Finally, the door is removed and a mechanical unloader pulls out the coke. The ovens are then refilled.

In this area about 28 per cent of the coal goes up as smoke, and this, according to the United States Bureau of Mines, contains by-products worth almost as much as the coke itself. In 1920, 24,000,000 tons of coal were used to make 16,000,000 tons of bee-hive coke in Pennsylvania. The principal by-products wasted during this conversion were tar, 216,000,000 gallons; ammonium sulphate, 600,000,000 pounds (capable of being used for fertilizer); light oils, 72,000,000 gallons; gas, 120,000,000,000 cubic feet (capable of being used for public utility service).

The total manufactured gas made and sold to the public in Pennsylvania is only 27,000,000,000 cubic feet. Thus the gas wasted from bee-hive ovens represents about four and one-half times the amount of manufactured gas sold in the state.[5]

FIGURE 6.—A row of bee-hive ovens in the gloomy, unhealthful Connellsville region. These ovens keep the sky dark with the clouds of smoke they belch forth day and night. In 1923 there were in western Pennsylvania, Pittsburgh's tributary area, 37,578 bee-hive ovens. But despite this large number, the retort oven is crowding out and will eventually displace its rival. And it should, for it yields a greater amount of coke per ton, it makes coke of better quality, and it yields by-products that are nearly as valuable as the coke itself. No other single development has done so much to conserve this great natural resource for future generations as the by-product oven.

To stop this terrible waste, by-product or retort ovens have been installed in all of America's iron and steel districts. In 1923, 66 per cent of the country's coke and about 29 per cent of western Pennsylvania's was made in by-product ovens. The largest battery of by-product ovens in the world is installed at Clairton (Fig. 7). These save everything in the coal and even increase the yield in coke. They resemble immense drawers set close together on their sides. Huge mains built along the tops catch the by-products. About half the gas saved is used to heat the ovens themselves and the rest is used in the open hearth and heating furnaces of the steel plants. Nor is this all; after each ton has yielded about 69 per cent of coke, it yields also about 10,500 cubic feet of gas, 7.1

[5] The Smithsonian Institution's Study of Natural Resources Applied to Pennsylvania's Resources (Washington), 1923, p. 27.

gallons of tar, 2.4 gallons of crude oil, 20 to 25 pounds of ammonium sulphate or 5 or 6 pounds of liquid ammonia, and a little toluol.

Natural Gas

While the first well bored exclusively for gas was drilled in 1878 in the famous Murraysville District of Westmoreland County, the iron and steel mills refrained from using it until 1883, because they considered it a nuisance and they were afraid to risk large sums of money piping it from the producing to the consuming districts. At this time it cost about $7,500 to lay a mile of pipe; the line laid between Murraysville and Pittsburgh cost $135,000.

In 1886, however, the iron and steel interests began to see the benefits to be derived from gas, for it made more regular steam; reduced the cost of coal, of firing and of repairs to boilers and grate bars; and improved the quality of iron and steel. In "The Empire of Business" (page 275) Andrew Carnegie says: "In the manufacture of iron, and especially steel, the quality is improved by natural gas. Where we formerly had 95 firemen at work in one boiler house and were using 400 tons of coal per day, a visitor now walks along the row of boilers and sees but one man in attendance."

Three districts—Murraysville, Tarentum, and Washington—supplied Pittsburgh's great furnaces. By 1887, 96 plants were using gas and by 1889, 104. But from 1896 to 1915 the number greatly declined until today there are none.[6]

FIGURE 7.—By-product ovens at Clairton on the Monongahela River about 15 miles south of Pittsburgh. This battery of ovens is the largest in the world. This plant, a subsidiary of the United States Steel Corporation, occupies a most favorable site in relation both to the nearby iron and steel works and to the bituminous coal fields of the Connellsville District.

Gas was first used in puddling and in heating the furnaces and generating steam. Later it became a fortuitous factor in the manufacture of Open Hearth steel. Since it burns with a heat five times as great as its rival, coal gas, it made the operation of larger furnaces a comparatively easy matter.

FUEL CONSUMPTION OF THE IRON AND STEEL INDUSTRIES OF THE PITTSBURGH DISTRICT

In a district which produces so much steel—13,000,000 tons of ingots

[6] In 1920 only 16,000,000 cubic feet of natural gas (valued at $2,500) were used for fuel in Pittsburgh's iron and steel mills.

in 1920 [7]—great quantities of fuel are consumed. Table I shows that in 1920 Pittsburgh's iron and steel mills consumed 7,830,000 gross tons of fuel valued at $29,500,000. This was an increase of more than 500 per cent during the 10-year period.

It is significant that coal constituted two-thirds or $20,500,000 of the total value, $29,500,000, of fuel used under the boilers of Pittsburgh's iron and steel mills in 1920. The other classes of fuel and their approximate values were blast furnace gas $8,000,000+, by-product coke oven gas $900,000+, by-product tar $70,000+, and natural gas $2,500+.

The greater part of the iron used in Pittsburgh during the early stages of its industry came from two sources—Connellsville and the Juniata area of Center, Huntingdon, and Mifflin counties. The ore was reduced in local furnaces and shipped to Pittsburgh. The high value of Juniata iron enabled it to stand the hard and costly journey. It usually was bent into inverted U-shaped bars, which could be crooked over and around the

TABLE I
FUEL CONSUMPTION, STEEL PRODUCTION, AND GENERAL DATA ON STEEL WORKS OF THE PITTSBURGH DISTRICT

Year	*Gross Tons of Fuel Used Under Boilers*	*Value of Fuel Used Under Boilers*	*Gross Tons of Steel Ingots Produced*	*Gross Tons of Fuel Used Under Boilers per Gross Ton of Steel Ingots Produced*	*Value of Fuel Used Under Boilers per Gross Ton of Steel Ingots Produced*	*Value of One Gross Ton of Fuel Used Under Boilers*
1911	5,920,000	$6,500,000	10,400,000*	0.57	$0.65	$1.10
1912	6,850,000	9,200,000	11,800,000	0.58	0.78	1.35
1913	6,850,000	9,200,000	11,600,000	0.59	0.79	1.35
1914	5,470,000	7,400,000	8,900,000	0.61	0.83	1.35
1915	6,280,000	8,300,000	11,700,000	0.54	0.71	1.34
1916	7,400,000	10,900,000	14,100,000	0.53	0.77	1.48
1917	7,830,000	17,300,000	13,700,000	0.57	1.26	2.22
1918	8,250,000	21,700,000	13,000,000	0.63	1.67	2.63
1919	7,270,000	17,000,000	11,600,000	0.63	1.47	2.34
1920	7,830,000	29,500,000	13,000,000	0.60	2.27	3.76

* Estimated.

From Ely, S. B., and Rittman, W. F., "Power and Fuel Consumption of the Iron and Steel Industries of Pittsburgh," *The Blast Furnace and Steel Plant*, Nov. 1925, p. 454.

LOCATION OF PITTSBURGH WITH REFERENCE TO IRON ORE

Before 1850 many of the charcoal furnaces of Pennsylvania purchased their ore from farmers in the vicinity, who dug it on their farms and hauled it to the furnaces during the winter, their slack season. This ore was found in but moderate quantities in nests; only occasionally was it found in veins or strata. Some of this ore was considered very good, though most of it had a low iron content.

bodies of the horses, which travelled in packs of fifteen, each carrying about 200 pounds. When the Pennsylvania Canal and Portage Railroad was built in 1834, Juniata iron went that way to Pittsburgh.

In 1855, however, Lake Superior ore began to displace that from Pennsylvania. Larger furnaces and better fuel demanded larger amounts of higher-grade ores than were being worked in the Keystone State. Furthermore the low-grade ores near the

[7] Ingots are used as the basis of weights in connection with the production of iron and steel plants, for it would be impractical to use records of finished tonnages since the latter practice inevitably involves duplication and confusion of data.

existing blast furnaces were nearly exhausted.

The Lake Superior Region was opened in 1854 when ore was found in the Marquette Range; this was followed by the Menominee in 1877, the Vermillion and Gogebic in 1884, and the Mesabi, greatest in the world, in 1892. In this region two types of mining are carried on depending upon the local conditions. In the Gogebic, Marquette,[8] and Menominee ranges the shaft and tunnel methods prevail, whereas in the Mesabi, the Cuyana, and the Vermillion ranges the open-pit method triumphs. Ores either are Mesabi or "Old Range." The latter were discovered first and differ physically from Mesabi, they being hard and lumpy whereas Mesabi is fine and soft. They differ also in the way they act in the furnace. Some blast furnaces do not like to use straight Mesabi ore because its fine texture causes it to pack down in the furnace thereby preventing the free circulation of the blast. Consequently they prefer to mix Mesabi and "Old Range" so as to increase the air spaces. However, several operators told the writer that no irregularities occur when it is used with the hard coke and limeston of western Pennsylvania. A. J. Hain in the January, 1927, number of the *Iron Trade Review* says: "Blast furnace operators are becoming more particular regarding the size of the lumps of iron ore that is being shipped them. One of the earliest complaints against Mesabi iron ore was that it was too fine. Now that the 'cleaning up' stage has been reached at various mines, additional crushers are being built to reduce the large chunks that are mined. The present demand for ores uniform in size or containing lumps not exceeding a certain size is caused by the fact that modern blast furnaces are charged through the bell at the top and even distribution is necessary to insure best operation."

The Lake Superior Region began to ship ore to Pittsburgh as soon as the Sault Ste. Marie Canal was opened in 1855. Today it supplies not only the Pittsburgh District with ore but the entire country—85 per cent of the total originating here. In 1925 this region shipped 55,534,812 gross tons of iron ore. The chief reasons for its importance are: (1) The great abundance of the ore. E. C. Eckel places the available reserves as 2,500,000,000 tons. A. J. Hain, referring solely to Minnesota, gives the total merchantable ore in the ground and in stockpiles on May 1, 1926, as 1,297,452,605 tons. Hain refers only to Minnesota, whereas Eckel refers to the whole Lake Superior Region. If the latter figure be accepted, at our present rate of consumption, this would last slightly more than 20 years. (2) The high quality of the ore. Its iron content averages above 50 per cent (51.83 per cent in 1922). Furthermore it is not burdened with those more or less troublesome elements which are always found with iron—phosphorus, silicon, magnesia, sulphur, and aluminum. (3) The ease of mining it. Owing to the fact that the ore in the Mesabi Range, which makes up about two-thirds of the total Lake Superior output, lies close to the surface, covered only by a mantle of glacial till, it may be mined in open pits by steam shovels. Day and night these huge monsters labor, biting into the soft red ore with their

[8] The open pit method is employed in mining the silicious iron ore properties of the Marquette Range.

great jaws, snatching as much as 4½ tons at a single bite. (4) The relatively low cost of open pit mining, since the difficulties of underground operation are eliminated. Open pit is generally preferred to shaft mining because of its simplicity, safety, and certainty of results. (5) The cheap transportation to the lake ports and thence to lower lake ports. As fast as the cars are loaded, they are whisked out through the mine entrance to a railway yard, where they are sampled [9] and made into trains of 50 cars or more. Then they are hauled over automatic scales, where they are weighed and frisked away over the 80 miles to the ore docks on Lake Superior.[10] It is significant that not one of the iron ore ranges is more than 100 miles from navigable water

The ore docks, except those at Escanaba, are located on Lake Superior at Ashland, Duluth, Marquette, Superior, and Two Harbors. They are complex affairs of three levels: the docks proper jutt hundreds of feet into the lake; upon these beside a basin wide enough to admit the large ore boats, is a structure of heavy timbers whose upper sections form pockets for the ore; and on the very top are lines of railway tracks.

When the ore trains arrive, they move onto the ore docks, which extend into Lake Superior like enormous peninsulas, and their contents are dumped automatically into ore pockets. One dock contains 384 pockets with a total storage capacity of 153,600 tons. The pockets are spaced 12 feet from center to center so that when loading is going on the spouts will register with the hatches of the ore boat, which also are spaced on 12 foot centers. The empty cars are then switched over to the return track and hurried back to the mines.

A great ore boat then glides into the basin and is made fast to the dock. These boats are a "positive triumph of human design." They are built for carrying only iron ore,

FIGURE 8.—A lake boat at the head of Lake Superior taking on iron ore. These vessels are a "positive triumph of human design." Note the long, narrow body, broken only at bow and stern by deckhouses. Such a boat is ideal for carrying a huge cargo of from 10,000 to 14,000 tons at a fair speed, and for being loaded and unloaded rapidly. The ore chutes are spaced at 12-foot intervals so as to coincide with the hatches of the ship.

[9] This mine analysis gives an accurate knowledge of the chemical composition, which guides the blending and amounts of fuel necessary for the reduction of the particular mixture.

[10] At Proctor, the trains of ore which were sampled at the mines, are broken up by sorting engines and the ore from the different mines is placed together in train loads, so that when the ore is being dumped from the bins into the boats, certain definite mixtures of ore carrying the percentages of iron, silicon, phosphorus, and sulphur required at the particular furnaces, where the ore is to be treated, are built up.

coal, and grain. They are about 600 feet long and 60 feet wide and can carry a huge cargo at a fair speed and can be loaded and unloaded rapidly. As soon as the boat is made fast, the hatches are opened and from the ore pockets above are let down chutes (Fig. 8). The ore then goes crashing down the chutes and in 20 minutes 10,000 tons of ore have been loaded. The boat is usually moved along the dock so as to receive the proper grades of ore to make up the right mixture. When loaded the boat starts on its journey down the lakes. When it reaches the lower lake ports of Ashtabula, Cleveland, Conneaut, and Fairport, its cargo is quickly transferred to waiting trains by great unloaders, which grab 15 tons at a bite and unload a cargo in from four to six hours. As many as 13,000 tons have been unloaded from one boat in three and one-half hours. Any but an ore boat would require days to unload such a tremendous cargo. The trains, when loaded, are rushed to Pittsburgh, where the ore is placed in great stock piles. However, before it goes to the furnace it has to be analyzed again. This "natural analysis" forms the guide in determining the burden for the blast furnace. The "dry analysis," which was made at the mine, is ineffective for the present purpose, for the ore absorbs much moisture while exposed on the stock pile.[11]

The question now naturally arises as to why iron goes to coal rather than coal to iron. The answer is that ore is nearly always treated on the coal fields because it is more economical. Also since the largest demand for steel is in the populous manufacturing region north of the Ohio and Potomac rivers and east of Chicago, the ore should move to smelting centers in that section of the country. These centers are mostly along the shores of lakes Michigan and Erie or in that block extending from Pittsburgh to Wheeling to Lorain to Cleveland and back to Pittsburgh. On the whole the ideal places for the meeting of iron ore and fuel are the lake ports. Pittsburgh remains the capital of the industry primarily because of its early start and its proximity to Connellsville coal.

[11] Appleton, J. B., "The Iron and Steel Industry of the Calumet District," *University of Illinois Studies in the Social Sciences, Vol. XIII, No. 2*, p. 44.

THE LOCATION OF PITTSBURGH WITH REFERENCE TO MARKETS

The market has been and continues to be a salient factor in accounting for Pittsburgh's importance in iron and steel making. Keir states that while "raw materials, especially fuel, have had an important bearing upon the manufacture of iron, particularly upon the localization of the primary branch that transmutes ore into pig iron; nevertheless the power of the market has dominated raw materials, and even forced the adoption of new fuels. Consequently, the market has been at all times the most influential factor directing the destinies of the iron and steel business." [12]

Pittsburgh was relatively unimportant in this industry until after the first half of the nineteenth century, because the chief market for all iron and steel goods was east of the Appalachian Mountains, where the first railways were built, where manufacturing was prospering, and where the bulk of the population dwelt.

The decade 1850–1860 marked an epoch in American railway construction, for the mileage jumped

[12] Keir, M., "Manufacturing Industries in America" (New York) 1920, p. 96.

from 9,021 in 1850 to 30,626 in 1860—and more than one-third of this total was in Ohio, Indiana, and Illinois—Pittsburgh's hinterland. This middle-western region became a regular net of feeding and connecting lines for supplying the necessaries of life to the incipient civilization, and Pittsburgh, occupying a strategic commercial site, was advantageously located for reaping the benefits of this new trade.

Pittsburgh's being the center not only of America's primary but also of her secondary iron and steel industries.

The Market Beyond Pittsburgh

Until the elimination of the "Pittsburgh Plus" [14] in 1924, Pittsburgh was the absolute monarch of the steel industry, for her market was the whole United States, whereas that of Chicago, for instance, was confined to the city *per se* and a small area in

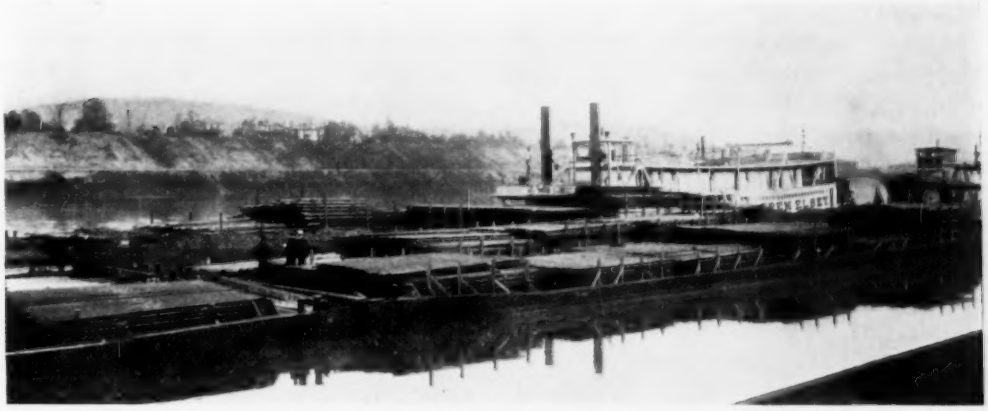

FIGURE 9.—A large tow of Pittsburgh steel destined for down river points. Large tonnages of pipe, structural shapes, tin plate, wire nails, barbed wire, woven wire fencing, and other steel goods from the Pittsburgh District are now being distributed from barges along the Ohio and Mississippi rivers and inland into the West and Southwest, the latter two regions being reached by transfer to rail at St. Louis and Memphis. The saving in transportation costs is appreciable (usually from $2.00 to $2.50 per ton on long distances) by the all water route, and is considerable even by the water and rail route if the haul by water is sufficiently long to offset transfer charges at river terminals. It seems impossible to overestimate the significance and value of Pittsburgh's rivers to her iron and steel industry. Just as they enabled her to bring coal cheaply to her waterside plants, so now are they enabling her to dispose of the finished products of these mills at an appreciable saving.

The Home Market

As Pittsburgh's iron and steel industry grew in proportions, new industries that depended upon these products chose the "Steel City," because of the saving in freight and because of its proximity to the ultimate market (Pittsburgh lies within 450 miles of 60,000,000 people or more than one-half of our total population).[13] This has resulted in the West. This situation, of course, stimulated production in Pittsburgh but retarded development as well as steel consumption in all other districts. As a result of this, during the interim 1908–1923, the capacity of the mills within a radius of 60 miles

[13] "Why Pittsburgh?" Pittsburgh Chamber of Commerce, pp. 6–7.

[14] "By 'Pittsburgh Plus' is meant respondent's (meaning United States Steel Corporation) system of prices for its said products manufactured at and shipped from points outside of Pittsburgh, which are f.o.b.Pittsburgh prices plus amounts equivalent to what the railroad freight charges on such products would be from Pittsburgh to each different destination if such products were actually shipped from Pittsburgh."

of Pittsburgh was increased 6,000,000 tons, whereas that within the same distance of Chicago was enhanced but 3,000,000 tons.

The elimination of the "Pittsburgh Plus" should certainly give Pittsburgh's competitors wider markets. According to the Federal Trade Commission, Docket No. 760, pages 11 and 12, the Chicago fabricator with the "Pittsburgh Plus" system eliminated, should be able to compete on an equality or at an actual advantage against the Pittsburgh fabricator as far as "a north and south line drawn substantially half way between Chicago and Pittsburgh. This line would run through Detroit and Toledo, east of Columbus and very greatly east of Cincinnati. In all the territory west of this line, the Chicago fabricator would have an advantage over the Pittsburgh fabricator, and in all territory east of this line the Pittsburgh fabricator would have an advantage."

However, great tonnages of Pittsburgh steel are now being sent by barge over the waters of the Ohio and Mississippi rivers west of the line demarcated by the Federal Trade Commission. In one day in 1926 30,000 tons [15] of steel products moved over these streams to Gulf ports in Texas and Mexico, and to Memphis and other points for shipment primarily to the oil country of the Tampico, Gulf, and Mid-Continent fields. Furthermore, penetration of steel products from the Pittsburgh District via barge as far as Kansas City for further distribution westward is purposed. Thus it appears that Pittsburgh is competing advantageously with Atlantic Seaboard and Birmingham firms in the Gulf Region and with Chicago and Birmingham concerns in the Mississippi Valley.

[15] Froggett, J. F., "Transportation Recasting Industrial Map of United States," *Iron Trade Review*, Jan. 6, 1927, p. 22.

LOCATION OF PITTSBURGH WITH REFERENCE TO TRANSPORTATION

Fundamental to the successful operation of any steel concern is its ability to have its iron ore, fuel, and limestone flowing uninterruptedly to its plants and its finished articles moving to market without delay. Pittsburgh, then, with its easy access to Lake Erie ports, its location at an important gateway through the Appalachian barrier, and its strategic site astride three rivers, is advantageously located for receiving raw materials and for distributing finished products.

TRANSPORTATION BY WATER

If Lake Superior iron ore had to be shipped to Pittsburgh by the all-rail route, the district would be so severely handicapped as to be unable to retain its prestige as America's premier steel center. But the Great Lakes, over whose waters pass more tonnage than over any inland waterway in the world, extend for more than 1,000 miles from the iron ore region of the Northwest to the populous, industrial, coal-producing region farther east, thus enabling Mesabi ore to move cheaply by water to within 141 miles of Pittsburgh.

Relation of Pittsburgh to the Great Lakes

The rate on ore to Lake Erie ports is exceedingly reasonable as is shown by the following figures. In 1913, lake steamers charged but 0.68 of a mill per ton mile, whereas the Lake Shore Railroad, which because of its easy grades and excellent road bed,

is ideal for cheap transportation, charged 5.29 mills per ton mile.[16] Since 1913 the charges of both carriers have risen, but they have done so proportionately, so that the comparison still holds. These figures show how significant to America's vast steel industry is this link of 1,000 miles of water between Duluth and other Lake Superior ports and lower lake ports.

Of course Pittsburgh is not so advantageously located for getting this ore as South Chicago, Gary, Toledo, Lorain, Cleveland, and Buffalo, for they reap the economy resulting from having blast furnaces adjoining the ore docks where the lake steamers discharge their mountains of ore. Manufacturing at these points requires one less handling of the ore than at inland Pittsburgh.

It costs $1.23 more to lay down a ton of iron ore at Pittsburgh than at Chicago or Cleveland. But the "Steel City" counterbalances this disadvantage by getting cheaper fuel. Pittsburgh gets its coal transported via rail from Connellsville for $1.13 per net ton and from the California District (Pennsylvania) on the Monongahela via barge for 50 cents and up, depending upon the volume.[17] The Chicago District, on the other hand, pays from $3.09 to $3.29 per net ton from eastern Kentucky and West Virginia via the all-rail route and about 50 cents less by the rail-lake route.[18]

[16] It should be realized that regardless of its efficiency in organization, no one railway could handle so great a tonnage of bulky material.

[17] Kellar, A. S., Secretary of the Natural Resources Division, Pittsburgh Chamber of Commerce. Personal Communication.

[18] Appleton, J., "The Iron and Steel Industry of the Calumet District," *University of Illinois Studies in the Social Sciences* (Urbana), 1927, p. 65.

FIGURE 10.—Looking down the Ohio River from Mount Washington opposite the "Point." This photograph shows the dissected nature of the plateau and the restricted area of level land, so characteristic of the region. It portrays the influence exerted by drainage lines on the distribution of railway lines. The Pittsburgh and Lake Erie tracks hug the very banks of the river while those of the Pennsylvania (the Connellsville Division) cling to the cliffs just above. In the foreground the bridge of the Westside Belt Railroad crosses the highway which is wedged in between the two trunk lines.

Relation of Pittsburgh to its Rivers

Pittsburgh lies in the maturely dissected Allegheny Plateau (Fig. 10), which is a labyrinth of sharp, deep valleys in which are several navigable rivers. These streams opened the finest bituminous coal field in the world, and Pittsburgh, located at the confluence of the Monongahela and the Allegheny and at the head of the Ohio, became the most convenient point of access to the coal field and the natural place for its earliest development. The service of these streams to Pittsburgh is great; Secretary Herbert Hoover of the United States Department of Commerce stated recently that the freight transported on the Monongahela, the Ohio, and the Allegheny rivers in 1923 exceeded that of the Panama Canal by 3,173,455 tons.

The Monongahela River

The Monongahela is America's most used river. Less than 130 miles long, it bears traffic reaching 24,000,000 tons annually—an amount surpassing that of either the Panama or the Suez Canals.

FIGURE 11.—The *rolling stock* of the rivers. Barges are used to transport raw materials as well as finished products to and from the mills of this great industrial region. Barges such as those shown here are among the largest in service. They draw about 8 feet of water when loaded and have a capacity of about 800 tons, 16 times that of the 50-ton gondola car.

It has been canalized so that coal may be loaded onto barges which are floated to the blast furnaces and waterside factories at Pittsburgh. In this canalization, the river has been converted into a system of pools by building dams at frequent intervals with locks for the passage of boats. These improvements have overcome the natural handicaps of low water in late summer and in autumn and the floods of spring. No important obstacle to water transportation now remains; ice has never interrupted transportation, since the constant stream of traffic prevents it from becoming thick.

At low water this stream discharges into the Ohio only 140 cubic feet of water per second. Before it was improved, only rafts and flat boats of one foot draft could navigate the entire course. Improvement for navigation on this stream became absolutely necessary, since productive mines lined its banks and the world's greatest coal market stood at its mouth. Fifteen locks and dams were built and a low water depth of from 7 to 8 feet maintained over all but one stretch of some 19 miles where the depth remains less than 6 feet at low water.

A most common sight on the Monongahela is the barge with its cargo of fuel (Fig. 11). It is claimed that out of a total of about 18,000,000 tons of coal used annually in the Pittsburgh Metropolitan District, no less than 10,000,000 tons, or five-ninths are water borne on this stream. The United States government and the people are annually saved $150,000,000 on freight rates by the use of the Monongahela River alone.

The Allegheny

This river, while not nearly so useful to man as the Monongahela, is nevertheless important. It is navigable for boats of very light draft to beyond the New York state line, and in 1920, a record-breaking year, transported 4,948,276 tons of freight; in 1921, a year below normal, it transported 3,737,444 tons of freight. The Allegheny contains many obstructions and is badly in need of improvements.

The Ohio

As the nineteenth century came to a close, Andrew Carnegie, seeing the potentialities of the Ohio River for the economical transportation of steel said, "One of the features of the coming century is to be a return to water transport for heavy materials. . . . Barges will ply upon the Ohio River soon to be slack-watered . . . and many other waterways will be opened upon which the raw materials for steel and the finished article itself are to be carried by manufacturers. . . ."[19] The prophetic significance of this statement is illustrated by the fact that the total tonnage on the Ohio River jumped from 10,866,683

[19] Carnegie, Andrew, "Development of Steel Manufacturing in the United States," *The Nineteenth Century*, New York, 1901, p. 152.

in 1924 to 15,737,015 in 1925 and to 18,000,000 (estimated) in 1926, of which more than 500,000 tons were iron and steel products and 6,500,000 coal.[20]

But the Ohio will be far more important after 1929, when the 52 dams and locks now under construction for insuring a year round stage on the 968 miles between Pittsburgh and Cairo are completed. This is one of the most ambitious projects for river navigation improvement ever undertaken, the cost being in excess of $100,000,000. That the project has promise and will be of great value to Ohio River cities and especially Pittsburgh is shown in the remark of Major E. L. Daly in charge of United States Army engineering work in the Pittsburgh District, that the completion of the river improvements will make Pittsburgh "absolutely the monarch of the steel industry. . . . When the Ohio is completely canalized, no other city in the United States and no foreign country will be able to compete with Pittsburgh in steel because of the lower freight rates the river transportation will afford."

Great preparation is going on in the Pittsburgh District for resuming distribution of steel products in barges via the trunk-line waterways of the Ohio and Mississippi valleys, which now are interrupted during the drouth of summer and fall by the lack of dams and locks in the lower part of the Ohio Basin. More than 40 of these dams have been completed giving a 9-foot depth at low water between Pittsburgh and Louisville.

Many thousands of tons of coal and steel are sent down the Ohio annually to Huntington, Cincinnati, Louisville, Evansville, St. Louis, Memphis, and New Orleans. On one day during 1926 tows of steel aggregating 30,000 tons moved over this river to lower Mississippi ports for export and to Memphis and other points for shipment to the great Mid-Continent oil field.

Thus far little effort has been made to secure a return cargo because too much time is required going against the current, though occasionally barges of steel ply upstream from Portsmouth to Parkersburg. To date it has been desirable to return to Pittsburgh as quickly as possible in order to prepare for the next trip.

Great economies are being effected through this barge service. It is pointed out that it costs a Pittsburgh nail producer $16.40 per ton to move a carload of nails from Pittsburgh to Shreveport, Louisiana, by the all-rail route (1922).[21] By sending the nails via barge it costs $5.00 a ton. Down-river customers of steel producers who are delivering their products by barge are saved from $2.00 to $4.00 per ton. As an example, on a shipment of 8,000 tons, it was estimated that $20,000 was saved over the equivalent all-rail freight rates, to say nothing of the increased speed in delivery.

One of the biggest handicaps to river transportation at the present time is the poor terminal facilities almost everywhere and the antiquated loading and unloading machinery. But these are being improved somewhat by civic bodies and steel companies.

Proposed Pittsburgh to Lake Erie Canal

At Washington several years ago the National Rivers and Harbors Congress stated that if Pittsburgh

[20] Froggett, J. F., *op. cit.*, p. 22.

[21] Lloyd, W. H., "Steel Manufacturers Utilize Great Inland Waterway," *The Iron Trade Review*, May 11, 1922, p. 1327.

and vicinity were to maintain its unique position as "the greatest tonnage producing district in the world," the Pittsburgh to Lake Erie Canal would have to be built soon.

The value of such a project would, of course, be invaluable to inland Pittsburgh. This canal would have a depth of 12 feet and a length of 101½ miles, and would extend from Beaver on the Ohio River to Lake Erie at Indian Creek. No material engineering difficulties are in evidence. The canal as proposed could support an annual traffic estimated at about 38,000,000 tons.

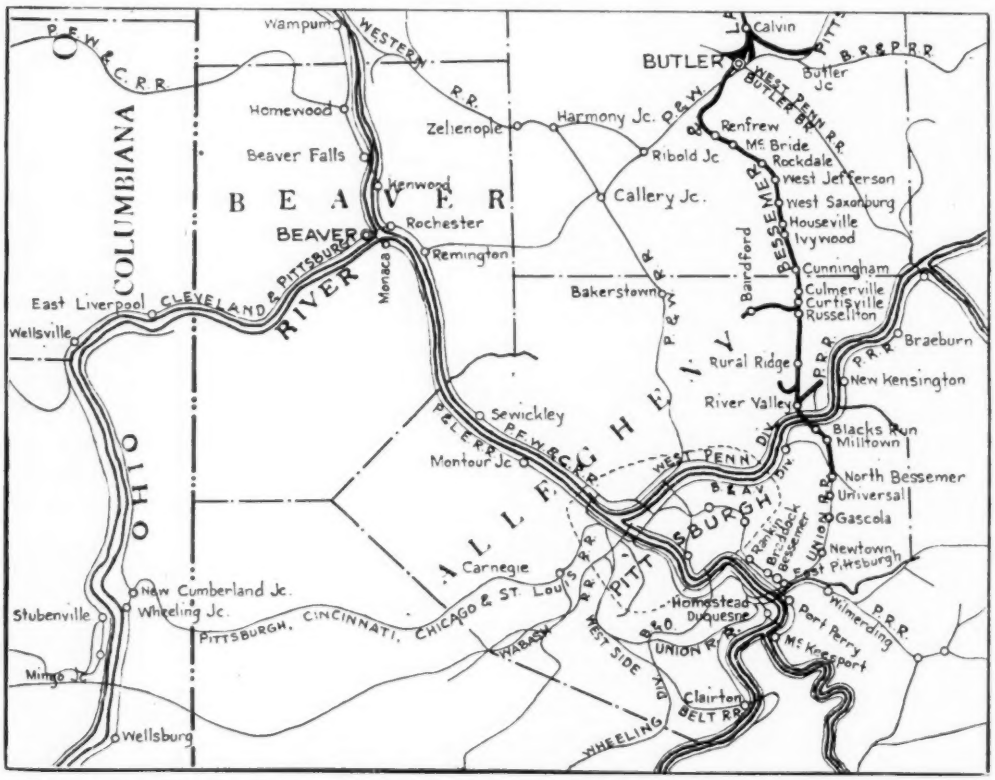

FIGURE 12.—The distribution of railways in Pittsburgh's tributary area. Even on this map, the location of transportation lines as influenced by drainage is apparent. A maze of steel rails borders every water course, large and small, in this portion of Pennsylvania.

TRANSPORTATION BY RAIL

In the Pittsburgh area, the railways are forced to follow valleys or the ridges between them. In either case the course is determined by drainage lines. As a matter of fact nearly all the railway mileage is found in the valleys (Fig. 10) and this despite the fact that the distance is frequently increased 50 per cent or more over the air-line route. Bearing these facts in mind it is quite significant that all the streams in this part of the state converge on Pittsburgh. This down grade greatly facilitates the movement of the bulky fuel (much of the coal and 98 per cent of the bee-hive coke is transported by railway), iron ore, and limestone—the necessary raw materials for Pittsburgh's great titans of industry.

Nine trunk lines radiate in all directions from Pittsburgh—integral

parts of the Pennsylvania Railroad and the Pennsylvania Lines; the Baltimore and Ohio; the Buffalo, Rochester and Pittsburgh; the Pittsburgh and Lake Erie; the Pittsburgh, McKeesport and Youghiogheny (New York Central); the Pittsburgh and West Virginia (Wabash); the Western Maryland, and the Bessemer and Lake Erie (Fig. 12). These give the city excellent access to a large tributary area.

The Bessemer and Lake Erie Railway

In any paper treating Pittsburgh's iron and steel industry, special attention should be given the Bessemer and Lake Erie Railway, a subsidiary of the United States Steel Corporation, which was brought by Andrew Carnegie from Conneaut to Pittsburgh by "the back door" in defiance of the Pennsylvania and the Baltimore and Ohio Railways, which claimed that they could handle all the tonnage of the United States Steel Corporation. As a matter of fact this route does not actually enter the city *per se*, but has its terminus at North Bessemer, where the Union Railway, also a subsidiary of the Steel Corporation, joins it and serves the Pittsburgh plants.

This line nearly attains the ideal from a tonnage standpoint. It maintains a balance which contributes notably towards efficient and economical transportation. For instance, in 1920 the tonnage was about equal in both directions—being 49 per cent northbound freight and 51 per cent southbound. The slight variance is attributable to the fact that the southbound ore tonnage was hauled the entire length of the road. During 1920 this line moved 18,660,414 tons at a cost of only 1,134,011 freight ton miles.

The importance of this railway to the iron and steel interests of Pittsburgh is shown by the fact that in 1925 it transported 63 per cent or 8,612,761 gross tons of the 13,600,000 gross tons of iron ore that made its way from Lake Erie ports to the Pittsburgh District.

The most important single item on northbound trains is coal, which constitutes about 29 per cent of the total tonnage. A small amount of iron and steel—15,340 net tons in 1925—is shipped to Conneaut. The other items would correspond with those carried by all railways.

Since this line is a subsidiary of the Steel Corporation, one might suppose that that organization would possess marked advantages over other Pittsburgh shippers of steel products. But it does not, except that it derives dividends from its investments in the property. The Bessemer and Lake Erie has the same basis for rates as the other railways in the region.

LOCATION OF PITTSBURGH WITH REFERENCE TO LIMESTONE

Two of the fundamental ingredients of iron making have already been treated—coal and iron ore; limestone is the third. It serves as a flux, uniting with the impurities of the ore, thereby aiding their elimination (page 116). It also aids in melting the ore.

The limestone used in Pittsburgh's blast furnaces comes principally from Huntingdon County, a little more than 100 miles away, and is brought by rail.

Not much need be said concerning limestone in this study, since it has exercised a very limited control in the localization of the industry.

LOCATION OF PITTSBURGH WITH REFERENCE TO LABOR

Little need be said regarding the labor supply, for it is a minor factor in the location of the iron and steel industry. Suffice it to say that Pittsburgh's mills employ native Americans, foreigners, and negroes, the two latter classes having been imported to do the unskilled labor.

Only one phase of labor—the cost in Pittsburgh compared with that in other districts—merits treatment in so brief a survey as this. Table II [22] indicates that laborers in the Pittsburgh and Chicago Districts receive higher average hourly earnings than those in the Eastern and Southern Districts, and that those in the Pittsburgh District get more in six out of nine departments than those in the Chicago District.[23]

TABLE II
AVERAGE HOURLY EARNINGS IN EACH DEPARTMENT, ALL OCCUPATIONS COMBINED, 1924, BY DISTRICT

District	*Blast Furnaces*	*Bessemer Converters*	*Open-Hearth Furnaces*	*Puddling Mills*	*Blooming Mills*	*Plate Mills*	*Standard Nail Mills*	*Bar Mills*	*Sheet Mills*	*Tin-Plate Mills*
Eastern	$0.496	.....	$0.533	$0.652	$0.594	$0.433	.....	$0.583	.....	.....
Pittsburgh	.561	$0.636	.642	.897	.629	.609	.....	.626	$0.829	$0.843
Great Lakes and Middle West	.576	.610	.671	.717	.628	.620	.....	.613	.784	.697
Southern	.380	.....	.572	.506	.506	.....	.....	.428	.....	.....
Total	$0.520	$0.624	$0.635	$0.721	$0.613	$0.562	$0.573	$0.585	$0.809	$0.795

DISTRIBUTION OF BLAST FURNACES AND STEEL MILLS IN THE PITTSBURGH DISTRICT

We have now seen how coal, iron ore, limestone, market, transportation, and labor have played their rôles in contributing to Pittsburgh's preëminence in the world of iron and steel. We must now analyze the geographical distribution of the plants.

One of the most significant aspects of the distribution of iron and steel plants in this district is their concentration on rivers, consequent upon the following conditions:

(a) The mills need an abundance of soft water for cooling, gas washing, and steam. Next to air water is the most essential resource in determining the specific site of plants. It is estimated that the entire average discharge of the Monongahela is used several times as it flows past the furnaces and steel mills along its course. This fact becomes apparent when one compares the black and dirty ore and coal dust laden waters of the Monongahela with the muddy water of the Allegheny (Fig. 13).

(b) The mills benefit from cheap carriage via water; coal is economically transported from the mines down the rivers, and an increasing tonnage of steel products is being taken by barge down the Ohio and Mississippi rivers to important urban distributing centers and export points at a less figure than would be possible by rail.

(c) The mills must be advantageously located with reference to railways which convey the iron ore from Lake Erie ports and the coal and limestone from the tributary area.

[22] *Wages and Hours of Labor in the Iron and Steel Industry: 1907 to 1924. Bulletin Number 381*, Bureau of Labor Statistics (Washington), 1925, p. 11.

[23] Table II shows by districts the average hourly earnings in 1924 in each department as a whole, all occupations combined. The average was obtained by dividing the total earnings by the total hours worked.

FIGURE 13.—The "Point" where the Allegheny and the Monongahela merge to form the Ohio. The barges of coal anchored here await consignment to the mills along any one of the three rivers. Note the distinct line formed by the dark ore and coal dust-laden water of the Monongahela on the right, and the muddy water of the Allegheny on the left. The business section of the "Steel City" is built on the triangle between the rivers.

In the narrow valleys of this dissected plateau the railways of necessity hug the banks (Fig. 14) and the down haul on the heavy and cheap products to the riverside plants is highly advantageous

(d) The mills need level land for the expansion of old plants and for the erection of new ones. But the level land in this district is limited and is confined to the narrow ribbon of river flood plain. This is a severe handicap to the "Steel City" and is beginning to show its effects; for instance the plant of the Crucible Steel Company, one of the oldest in Pittsburgh, located on the Ohio River near the "Point" has been sold recently and dismantled because it could not expand (Fig. 15). Level land in Pittsburgh itself is all acquired. It is in great demand by the railways which need to expand their yards.

In addition the following minor factors should be mentioned:

(a) More mills are located along the Monongahela than along the Ohio or the Allegheny, because most of the economically water-borne coal comes down the former and because it has been greatly improved for navigation (Fig. 16).

(b) Several plants are now extending their operations by moving to some of Pittsburgh's satellite towns; the Crucible Steel Company has moved to Midland, some thirty miles down the Ohio from the "Point," while the Jones and Laughlin Steel Company has bought two islands in the Ohio near the south bank at Aliquippa, and has obtained permission from the government to fill in the inner channel. These new plants will be advantageously located with reference both to Connellsville coal and down-river markets.

ADVANTAGES AND DISADVANTAGES OF PITTSBURGH—PAST AND PRESENT

Pittsburgh rose to its position of prominence because, during the latter

FIGURE 14.—A solid train of 80 cars of coke being pulled by one locomotive on the Connellsville-Pittsburgh Division of the Pennsylvania Railroad enroute to Pittsburgh's iron and steel mills. In this region, where the cheap, heavy, bulky commodities such as coal, coke, iron ore and limestone all are destined for Pittsburgh, transportation is greatly facilitated by the down-grade, which is consequent upon the fact that all the streams and therefore all the railways converge upon Pittsburgh.

half of the nineteenth century, it had the most advantageous location in the country for steel manufacture.

It has retained first place in this industry because (1) of its proximity to the world's best coking coal at Connellsville; (2) of its proximity to the lower lake ports of Ashtabula, Conneaut, Cleveland, and Fairport to which Lake Superior ores are cheaply transported by water in specially designed boats; (3) of its strategic location with reference to the great steel markets of the country; (4) of the momentum of an early start or the tendency of great plants

FIGURE 15.—Conquered by the city. This mill, one of the oldest in the district, has been purchased by the Pittsburgh and Lake Erie Railway whose tracks skirt the river. The railway is dismantling the mill in order to use its site for a produce yard. This narrow strip of flood plain, about 300 feet wide and a half mile long, is located on the south side of the Ohio River not far from the "Point." Such sites are no longer desirable for mills, since they offer no opportunity for expansion.

involving a tremendous outlay of capital to remain where they became established; (5) of the "Pittsburgh Plus" (abolished in 1924); and (6) of excellent transportation facilities, both rail and water.

However, the frontier of steel-making seems to be moving westward, because factors are at work which are disadvantageous to Pittsburgh. These are: (1) the lake ports such as Chicago, Gary, Cleveland, and Buffalo are taking an increasing proportion of the steel business, because they are more economical of transportation. In Pittsburgh some of the fuel and all the iron ore and limestone are shipped to the furnaces via rail. A lake port avoids one handling of the ore and limestone by simply extending the journey of the coal to its by-product ovens; (2) Connellsville no longer has a strangle hold on smelter fuel. So long as coke was made entirely in wasteful bee-hive ovens, the number of coking coals was limited, with Connellsville ranking first and Pocahontas second. But the by-product oven has largely displaced the bee-hive oven with the result that a wider variety of coals is now being successfully coked. In 1923 even in western Pennsylvania, the stronghold of the bee-hive industry, 29 per cent of the coke was made in retort ovens. This new process of coke-making has been one of the potent factors leading to the decentralization of the iron industry; (3) the "Pittsburgh Plus" was abolished by the Federal Trade Commission in 1924; (4) the nation's steel consumption is growing much more rapidly in the Middle West than in the older East, which means that Chicago has an advantage over Pittsburgh in consumptive capacity, and (5) there is a dearth of level land on the rivers for expansion either of established plants or for the erection of new ones. All the land suitable for iron and steel manufacture is occupied and the future development of the city must take place in the satellite suburbs and cities. This situation, of course, is in sharp contrast with that in the Chicago-Gary District, where the shore of Lake Michigan offered miles of cheap unoccupied land, which was acquired by the steel interests in immense tracts.

THE PROBABLE FUTURE

Will Pittsburgh continue to lead all other districts in iron and steel production? Its output is growing steadily, though not so rapidly as that of the Chicago-Gary District. In all probability the contest for supremacy lies between Pittsburgh and Chicago.[24] The victor of this struggle must meet two rigid requirements: (1) it must be nearer than its rival to the nation's chief market and (2) it must be able to produce its steel more cheaply.

Concerning the first we know that production naturally is consequent upon consumption, which in turn is consequent upon population. For decades our population has been moving in the direction of the setting sun and so it will continue for many more. "Since 1840 the center of population has been trending irresistibly away from Pittsburgh, but not for twenty years after it had crossed the freight rate boundary line between Pittsburgh and Chicago did the Chicago district begin to react to the consumptive capacity springing up at its gates. The freight rate structure was designed naturally, to

[24] In this paper the term "Chicago" is synonymous with the Chicago-Gary or the Calumet District.

favor Pittsburgh, in what is now disputed territory, and considerable advantage still accrues to Pittsburgh." [25] Thus the superiority of Chicago over Pittsburgh relative to our center of population and, therefore, to consumptive capacity is indisputable.

Concerning the second requirement, we know that the district which can assemble most economically high grade fuel, iron ore, and limestone will dominate, *providing it is strategically located with reference to a large market*, because of the overwhelming importance of their cost in the production of pig iron. For instance in 1923 it cost about $25.00 to make a gross ton of Eastern Foundry pig iron. Of this amount raw materials accounted for $21.25 (ore $9.50, coke $10.50 and limestone $1.25), labor $1.75 and other costs $2.00.[26]

Unfortunately *reliable* information on the cost of producing steel at Pittsburgh and Chicago is unobtainable; the Federal Trade Commission in Docket No. 760 states in several places that the cost of producing steel in plants of the United States Steel Corporation in Chicago is approximately 20 per cent less than in its Pittsburgh plants. On the other hand, as recently as 1922, Judge Elbert H. Gary, Chairman of the Board of the United States Steel Corporation, stated that Pittsburgh is the cheapest point of production.[27]

Chicago pays less for iron ore and limestone, gets slightly cheaper labor, lies nearer the center of population

FIGURE 16.—The Monongahela throbs with industry, for it supplies the mills with an abundance of water—a most essential element in iron and steel industries—and it has been improved for navigation so that coal can be brought by barge from the mines directly to the plants during every month in the year. In just this Oakland section of Pittsburgh we see the river's banks lined with great mills as far as the eye can reach. These work night and day ejecting their varied colored smoke into a sky where the sun *seldom shines*. The well rounded hills farther back lift the homes of the workers above some of the smoke and grime of the furnaces. But nevertheless the whole district is dirty and unhealthful. Huntington and Williams in *Business Geography*, page 101, show that in early childhood the death rate among both boys and girls is 30 to 40 per cent greater in Pittsburgh than in Philadelphia. Also that a young man in the "Smoky City" between the ages of 20 and 24 has nearly twice the probability of dying as has a young man of the same age in the "Quaker City." They attribute this significant difference to the type of occupations and their effect on the air and on living conditions generally.

[25] *Iron Trade Review*, Vol. 78, Jan. 7, 1926, p. 42.

[26] Tyler, P. M., "Foreign and Domestic Pig Iron Costs," *The Iron Age*, Feb. 15, 1923, p. 467.

[27] *The Iron Age*, Dec. 28, 1922, p. 1719.

and therefore has near at hand a larger consumptive market, and has reduced its production costs as a result of its later development and its effect upon the adoption of the most recent equipment. On the other hand Pittsburgh pays much less for coal. Pittsburgh certainly is the capital of the industry today and bids fair to continue as such for some time, though perhaps with decreasing security.

Based wholly on its economic geographic advantages, it would seem that eventually Chicago must displace Pittsburgh as the capital of our iron and steel industry, since there the three basic raw materials meet scientifically the center of steel consumption. But another factor of inestimable significance is the influence of the great corporations which control the industry and have plants in practically every district. Their leaders may, for reasons unknown to any but themselves, prevent Chicago from taking full advantage of its geographic possibilities. Thus it would appear that the outcome of this struggle for supremacy between these two great districts, both of which will always have a tremendous home demand to supply, is of necessity highly problematical, and not safely predictable.

EUROPEAN FORESTS AND THEIR UTILIZATION

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TO attempt to treat the forests of Europe would seem to be futile; for, in the first place, the term "forest" is not exactly, nor uniformly, defined in many European countries; and in the second place, the data of acreage and distribution are incomplete and inadequate. Hence only a fairly accurate presentation, as nearly correct as present conditions and information permit, is promised.

The primeval forests of Europe are practically vanished. Only a very little original forest is left in central Europe, and not a great deal in eastern and southeastern Europe. Nearly every country, particularly Germany, has learned by bitter experience that complete denudation without reforestation is detrimental to the best interests of the state, and the sound economic development of its industries. With this lesson learned, every country has initiated a special forest service to preserve what woodland is left and to restore to forestry use as much of the denuded land as possible, with the result that much second growth and cultivated forest now occupies relatively great areas of the mountainous regions where crop agriculture and grazing are impracticable. Forest schools have been established, con ervative forest policies have been inaugurated, and the practice of forestry has been established as an important industry, especially in Germany. Conducted on a scientific basis these projects promote significantly the material welfare of the people.

America profited only in slight measure by the experience of Europe. The United States, for example, did not begin its development of forestry, and its forest service, until in the later part of the nineteenth century when enormous areas had been completely denuded and the forest cover entirely removed with consequent loss by erosion, fire, and other agencies, of the chances for natural reforestation. Since the establishment of the forest service the forests are being slowly restored, so that in 1925 the United States had 1,627,000 acres of new forest artificially established, a very slight beginning in the new world of a movement that began in Europe a hundred years ago and now affects hundreds of millions of acres.

It is rather difficult to map accurately the present distribution of forest area in Europe. Census data are available from most of the countries, but in some only an estimate can be made of the forested area. Consequently the figures in the accompanying table for some of the eastern European countries are mere approximations, though they do show fairly well the relation between the area of the different countries and other forest acreage. At present 2,110,980,000 acres of Europe are in forest, a little over 33 per cent of the total area of Europe.

The present subdivisions into which the forests are divided for administration are not small enough to give an exact and accurate view of the situation. No adequate statisti-

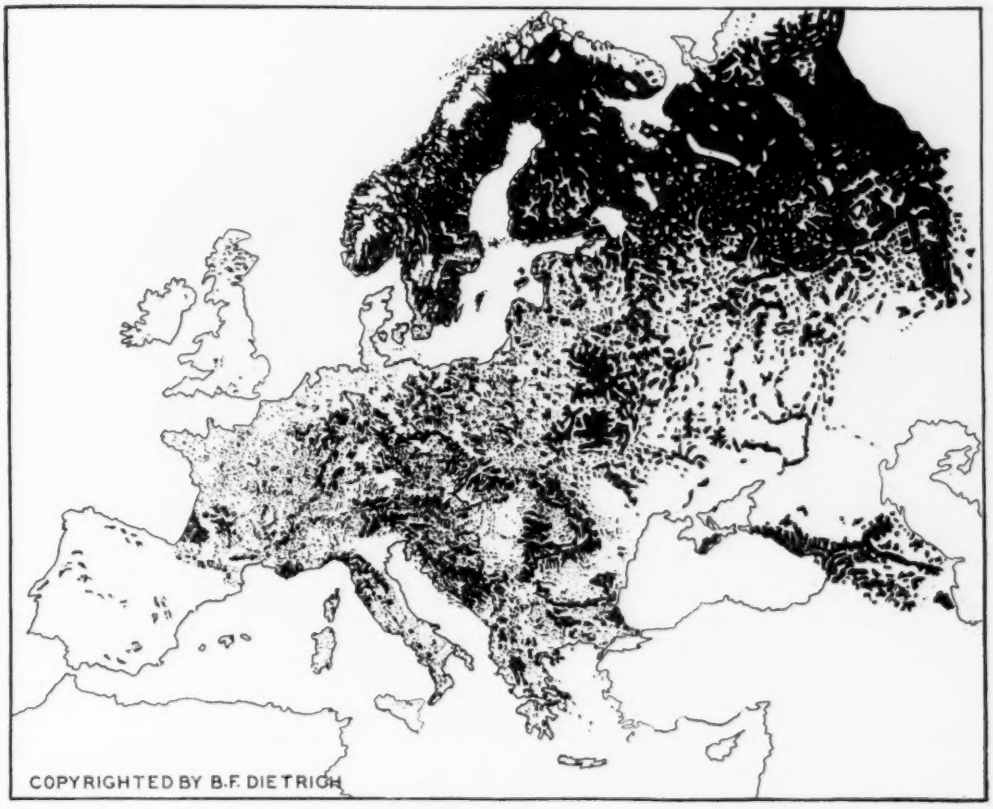

FIGURE 1.—The distribution of the forests of Europe.

cal material is available for dot maps which would give a correct impression of forest distribution. Only the percentage proportion of the forest area to the total area of the countries can be given; this is the only way at present to express the relation between the area of the forest resources and the area of the political regions of Europe.

TABLE 1
FOREST AREA OF EUROPE

	Forest Area in Acres	*Ratio of Forest to Total Land Area*
Austria	7,600,000	36.7%
Belgium	1,321,240	17.5
Bulgaria	7,515,420	29.4
Czechoslovakia	11,496,100	33.1
Denmark	872,000	7.5
Esthonia	2,220,000	18.8
Finland	49,410,000	60.0
France	25,556,300	18.8
Germany	30,905,840	26.5
Great Britain and No. Ireland	2,737,600	4.5
Greece	938,980	5.8*
Hungary	2,700,000	11.3
Ireland	248,880	1.4
Italy	289,070	0.4†
Jugoslavia	18,186,420	29.2
Latvia	5,282,500	29.3
Lithuania	2,180,000	15.7
Luxemburg	197,600	30.9
Netherland	644,480	7.9
Norway	15,557,760	21.6
Poland	21,881,140	22.8
Portugal	4,005,072	17.3
Roumania	21,758,000	27.8
Russia	1,781,260,000	34.0
European Caucasus	5,473,000	11.5
Spain	16,886,350	13.5‡
Sweden	60,722,480	54.8
Switzerland	2,437,000	23.9
Albania	300,200	27.0
European Turkey	1,393,300	24.0
Europe	2,101,976,732 acres	33.1%

* The percentage would be 12% if the macchia were included.

† The percentage mostly includes the macchia bushes and then amounts between 9% to 10%.

‡ Including macchia (estimated).

The names of the middle European mountains and settlements indicate the former great extent of the woodlands—Harz, Haardt, Spessart, Fich-

FIGURE 2.—A landscape in the Black Forest, near Freiburg, southwest Germany.

telgebirge, Boehmerwald (Bohemian Forest), Bayrischerwald (Bavarian Forest), Schwarzwald (Black Forest), Odenwald, and Argonnenwald—all of which help to show how widely the original forest was distributed. It was at the time of the first German invasion into central Europe that wood cutting and deforestation began on a big scale, when the open valleys could not satisfy the demand for new land for settlement. The forests were not only cut but very often burned to extend the agricultural land. Later in the 12th to the 14th centuries—the time of the city development in central Europe—after a brief period of rude tillage with wooden plows by the Slavic peoples, the German invaders renewed their vigorous extension of agricultural land and for a period of about two hundred years the forests were ruthlessly destroyed.

FIGURE 3.—Forests of the Odenwald, near Heidelberg, in the valley of the Neckar River.

Only in recent times has it been discovered, by economists and others, that the favorable balance between forests and other lands is necessary to a sound economic development of a nation. In some countries it was too late to preserve the forests. Great Britain, with only four per cent of her total land area left in forest, is an example of this lack of proper balance in land utilization. Important political consequences often followed in countries which wasted and thus lost their forest heritage. Such countries were forced to provide themselves with imported wood and became dependent upon foreign lands for it. Some countries in which the forests had not been so ruthlessly destroyed still possess great areas of virgin forest from which they are able to export timber both as raw and finished product. Thus Sweden and Finland have made their forests the bases of a great foreign commerce, and in no small measure their prosperity is dependent upon the intelligent utilization of their forest resources. Sweden has developed an exceedingly sound forest policy and Finland does not lag far behind. In a few other countries the amount of timber grown balances the amount cut. The chief industrial countries, and those which destroyed their forests to an extent which precludes the possibility of reforestation adequate to the lumber needs, must depend upon foreign sources for their timber requirements.

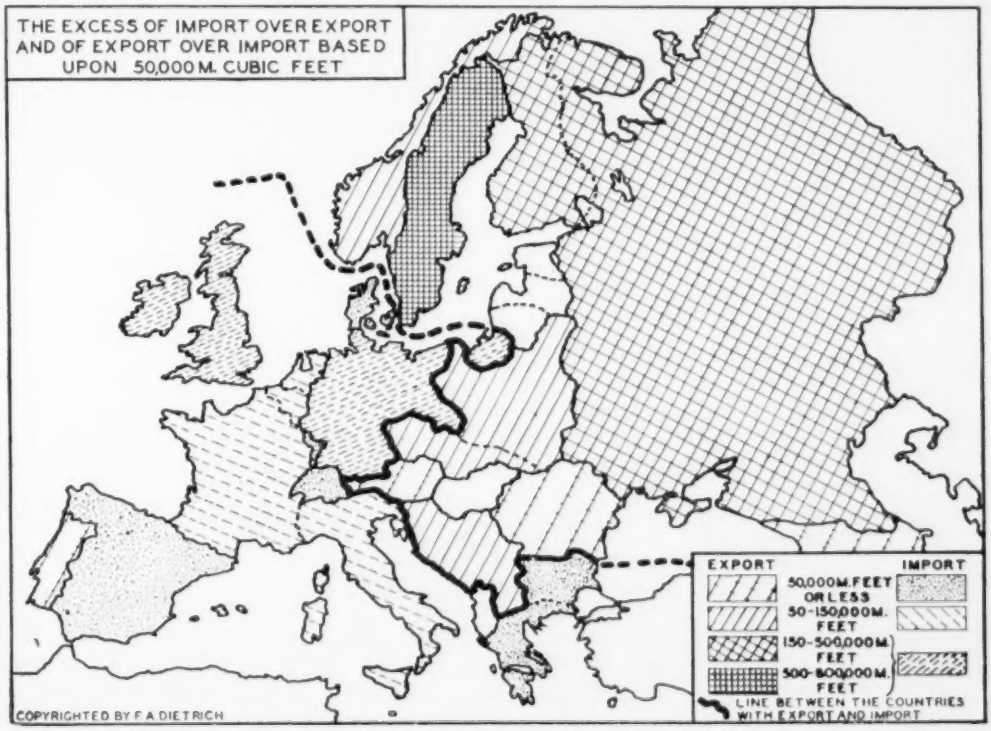

FIGURE 4.—Much of Europe has been denuded of its forests. In no part of the world is reforestation so general or so scientifically followed.

TABLE II

THE CHARACTER OF OWNERSHIP OF THE FOREST AREA

	State	*Communes*	*Private*	*Churches*
Austria	12.7%	22.9	64.4	...
Belgium	5.75	32.31	61.94	...
Bulgaria	29.7	51.5	17.1	1.7
Czechoslovakia	11.3	20.0	63.9	4.8
Denmark	24.0	29.0	47.0	...
Esthonia	86.4	(13.6)	...	...
Finland	35.1	....	64.9	...
France	12.1	22.4	65.5	...
Germany	30.1	20.6	47.3	...
Great Britain and No. Ireland	6.	....	94.0	...
Greece	80.	....	20.0	...
Hungary	12.	30.0	68.0	...
Ireland	?	....	....	...
Italy	2.8	57.0	40.2	...
Jugoslavia	42.2	37.4	15.0	6.4
Latvia	87.0	....	13.0	...
Lithuania	45.0	....	55.0	...
Luxemburg	7.0	....	93.0	...
Netherlands	30.6	....	69.4	...
Norway	15.0	6.0	79.0	...
Poland	32.9	....	67.1	...
Portugal	....	....	100.0	...
Roumania	49.0	....	51.0	...
Russia	100.0	....	....	...
European Caucasus	45.7	....	54.3*	...
Spain	5.1	94.8	0.1	...
Sweden	73.6	....	26.4	...
Switzerland	4.4	68.2	27.4	...
Albania	?	?	?	...
Europ.-Turkey	88.	6.	6.	...

* Unknown if the whole forest area is the property of country.

At present Europe as a whole is able to maintain itself in wood and wood products by reforestation and intracontinental exchange and movement of lumber and lumber products. When this ability to serve itself may end, when Europe must look abroad for her tremendous supply of wood, either to Asia or the tropical lands, no one can foresee.

The character of the utilization of the European forests depends upon their distribution and the policies adopted by the several countries concerned. In not all countries of Europe are the forests considered as natural resources; and the variation in economic systems of Europe is as great as the variation in agricultural development, so that sharp distinctions may be found between northern, central, and Mediterranean Europe, and between western, central, and eastern Europe.

The present distribution of forests in Europe depends on topography, climate, soil, and amount of wood cut. The main topographic control is exerted by the east-west extent of mountain and lowland as follows: the northern mountainous region, the northern lowland, the southern mountainous region, and the Mediterranean. The climatic control varies from the maritime climate of the Atlantic Coast to the continental climate of Asia, and from the subpolar climate of the Arctic tundra to the subtropical climate of the Mediterranean *macchia*, a major regional control.

In general the forest regions of the North are dominated by coniferous species such as pines, spruces, and firs. Southward a transitional belt extends across the Continent with mixed forests of coniferous and deciduous trees and this in turn gives way to a belt of dominantly deciduous trees. These forest belts are bounded in the North by the scrub of the subpolar belt and to the south by the Mediterranean *macchia* which resembles the American *chaparral*.

As has been stated the distribution of forest area in Europe was once much greater than at present. The real cause for the diminution of the forest area is of course the great influx of exterior peoples throughout the history of the continents, wave upon wave of foreigners flooding in upon the land and demanding room for settlement, agriculture, and the production of food. The great problem of Europe for many centuries has been the acquisition of more land, and still more land, for food and fiber production, always at the expense of the forested lands. The "Germania" of Tacitus is the first document in which the distribution of forests and wooded regions in central Europe is discussed. Since that time innumerable publications have dealt with the subject.

Only a general picture of the present distribution of forests can be given. Judged by forestry standards it is the character of the forests and not so much their area that has been changed. Reforestation standards now prevail and the area of forests is being extended in the countries of

At present the only profitable type of forests for development of an industry on a large scale is the pure stands of one or the other type. It is true that the scale of operation depends greatly on area as is shown by the rapid development of timber and timber industries in northern Europe;

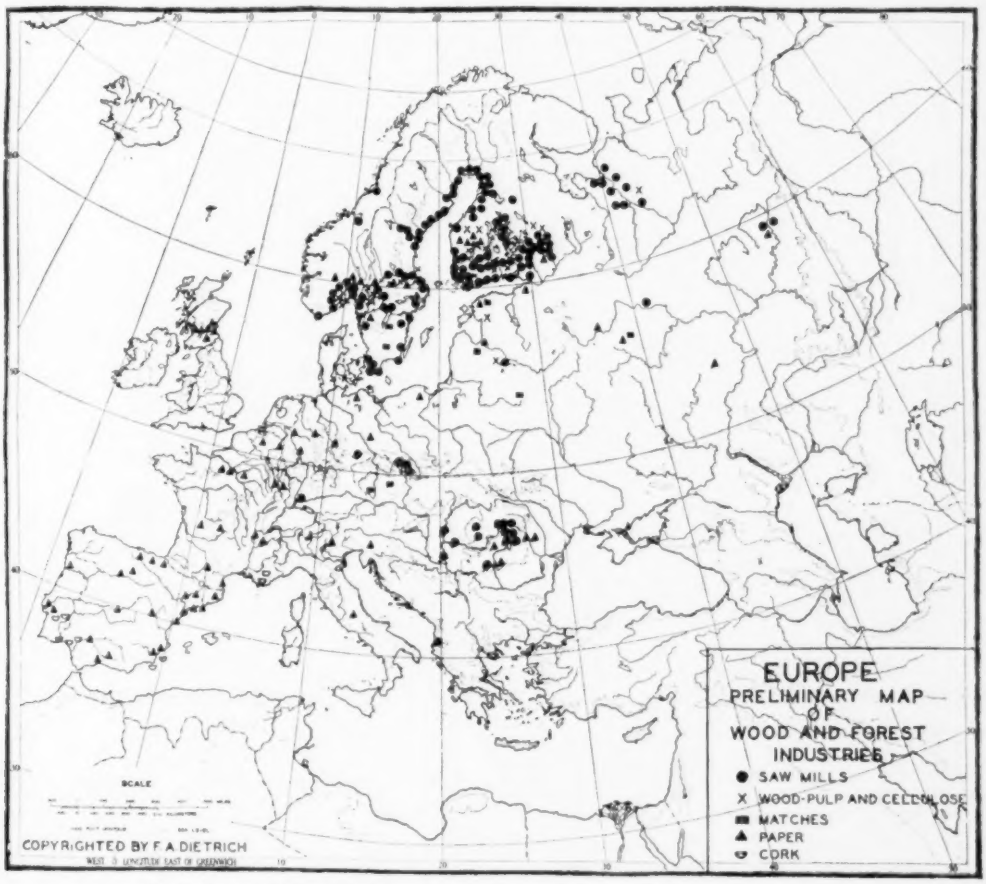

FIGURE 5.—The distribution of forest and lumber industries of Europe.

most enlightened forest policies; in others the forest area is diminishing. Other factors enter into the character of the forests, particularly the growth and kind of trees. From an economic viewpoint the most important distinction is that of forests of uniform type (of either coniferous or deciduous trees) and mixed forests.

or upon special use, as for cork in the Mediterranean oak region, resin in the pine region, or wooden toys in the mountainous region which depend on particular species of trees and their distribution.

Another important consideration for a forest policy is the question of age and growth of trees. Reforesta-

tion can be either natural or artificial, of which the latter implies the use of more scientific methods. Both systems of reforestation may change the character and value of forests as an economic resource. The original uniform forests of Europe are decreasing. The largest reserves of this type are the pine forests of Scandinavia, Finland, and eastern Europe. Likewise the number of countries with surplus timber is decreasing. Consequently cutting exceeds growth, and if the countries in which this occurs are to retain any significance in forestry, they must start reforestation (Table III). This reforestation in many places changes the composition of the forests, as for example in Germany, where pine or fir are strongly favored and replace many other species.

TABLE III

THE RELATION BETWEEN GROWTH AND CUT OF TIMBER 1922–1923

I. Group of countries with cut exceeding growth in cubic feet per acre:

	Meter Cubic Feet
Finland	1.5
Spain	2.4
Italy	3.4
Sweden	4.6
Denmark	5.2
Belgium	5.6
Jugoslavia	5.9
Latvia	6.1
Lithuania	6.6
Norway	6.6
Esthonia, northern	20.0

II. Group of countries with growth exceeding cut:

Great Britain * and Ireland		0.7
Switzerland	(about)	2.0
Roumania		3.1
Poland		5.0
Bulgaria		6.0
Germany †		10.0
Hungary		12.1
European Russia		13.0

III. Group of countries with balance between cut and growth:

Austria	Luxemburg
Czechoslovakia	Netherlands
France	Portugal

European Caucasus

* Great Britain is not put in the group, with the balance between growth and cut because the figure is small (0.7).

† The exceeding growth decreases rapidly.

In some regions the forest land is hopelessly lost. The early careless policy of destroying wood to gain new land for agriculture or of cutting timber without replacing the forest growth resulted in irreparable loss not only of the forest cover but the soil mantle as well. In others the replacement forest is not nearly so valuable as the virgin forest. In some countries the natural replacement forest is destroyed as fast as it grows by grazing of goats.

FIGURE 6.—The ratio of production of paper to consumption of paper is indicated by these charts in which the black indicates the latter, the white the former. Countries, with production greater than consumption, export paper.

For the purpose of this paper the main question is, What constitutes a forest? Is it possible so to define forest that those interested will agree? We must admit that this is exceedingly difficult. Further, the statistical material upon which we must depend, furnished by different governments or by private organizations, often differs for the same forest regions. It is difficult to determine whether the statistics are purely for forests or if they include the tree nurseries. It is equally difficult to determine whether the statistics for reforestation include natural replacement and secondary woodlands in which the character is quite different from the original cover. It is difficult to draw the limit for the subpolar region where dwarf trees like beeches are widely distributed.

And more difficult than any of these perhaps is the delimitation of forests in the region of macchia.

FIGURE 7.—The timber line in the high Alps in the Great Glockner Region.

Over vast areas of the Mediterranean regions there is no basis upon which the macchia may either be included or excluded. The statistics for some countries include even the areas of small bush macchia, others ignore them. In Italy and Greece, the countries with widest distribution of macchia, the statistics for forests are most inaccurate. Different figures for one and the same region in Italy vary as much as from 0.5 per cent to 16 per cent. In many cases the statistician, helpless in the face of these conflicting data, has arbitrarily fixed the national percentage of forest land for these countries as ten per cent. Another difficulty of considerable importance is the question of small isolated forest areas which in countries of large forest resources are excluded but in countries with small forest area are carefully included.

All these variations in statistics must be internationally standardized if a uniform and generally accepted definition of "forest" is to be made. If such a standard definition cannot be formulated or will not be accepted by the nations concerned, then accurate presentation of forest distribution, forest character, and forest value is impossible, and only approximate and rudely relative estimates can be made.

TABLE IV

EXCESS OF IMPORTS OR EXPORTS

I. Excess of *Imports* over Exports	
50,000 metric cubic feet or less:	Bulgaria, Denmark, Greece, Spain, Switzerland.
50,000–150,000:	Belgium, France, Italy, Netherlands.
150,000–500,000:	
500,000–800,000:	Germany, Great Britain.
II. Excess of *Exports* over Imports	
50,000 metric cubic feet or less:	Austria, Portugal, Roumania, European Caucasus.
50,000–150,000:	Czechoslovakia, Jugoslavia, Norway, Poland.
150,000–500,000:	Finland, Russia.
500,000–800,000:	Sweden.

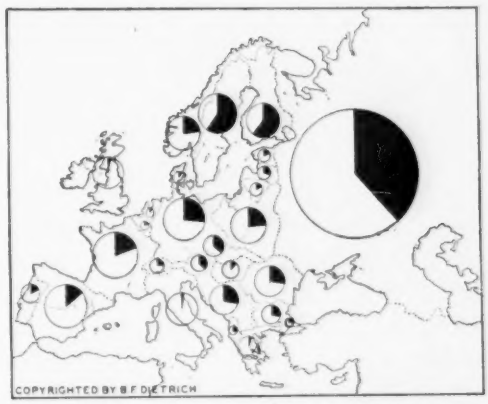

FIGURE 8.—The ratio of forests, indicated by black, to the total area, indicated by the chart. The areas of the charts indicate the relative areas of the several countries.

FOREST UTILIZATION BY COUNTRIES

In some countries the devastation has been great, while in others the utilization of the forests is an important factor in the export trade (Table IV).

AUSTRIA

In the new Austria, as it exists since the World War, considerable of

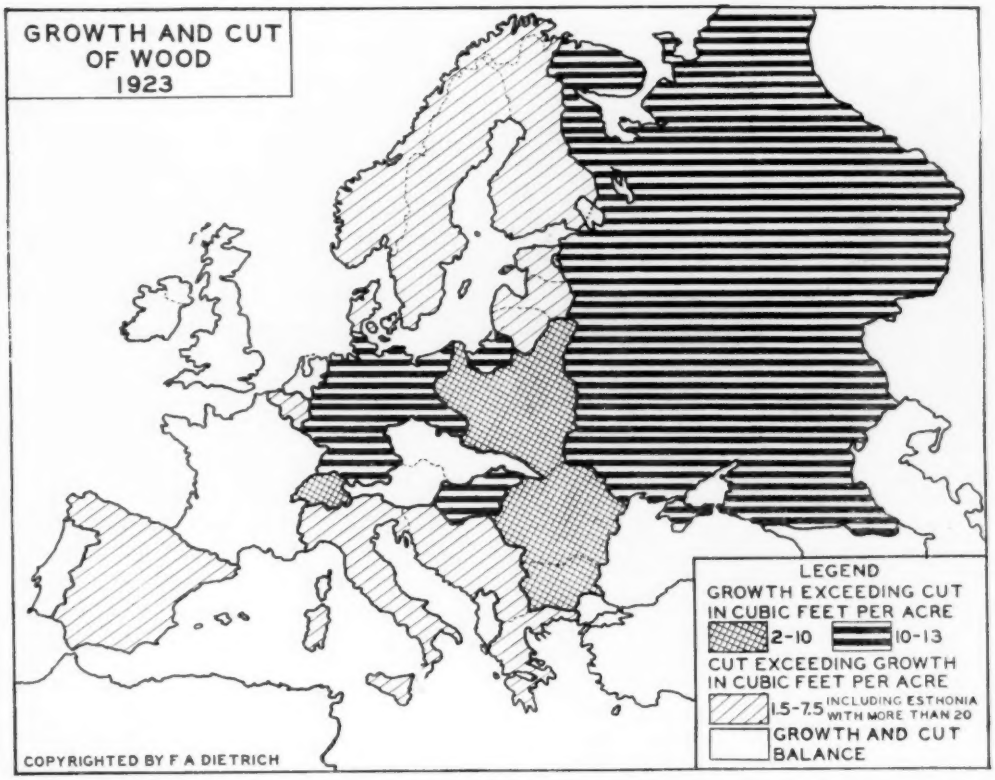

FIGURE 9.—An illuminating presentation of the present status of the forestry industry in Europe.

the area is covered with forests that make timber a significant commercial commodity. The forest service is excellently maintained in State forests, and in large private forests owned by the nobility. The farmers in the Alps, especially in Tirol, have the largest figures for cut in the whole country. Damage by ice, snow, and avalanche is very high. Austria still exports timber of which fir is the dominant species. In 1925 Austria's export of timber to Italy, Germany, Switzerland, and Hungary amounted to 1,300,000 tons with a value of 140,000,000 gold crowns.

BELGIUM

The sandy lowland provinces of Belgium, with the exception of Flanders, are covered with pines, while the hilly portions are covered with deciduous woods. Oak bark is used for tanning but the industry is decreasing just as in the Rhineland.

BULGARIA

Bulgaria is a classic example of forest devastation. In the early part of the nineteenth century while war raged between Bulgaria and Turkey, the latter burned great areas of forests. By the peace of the World War Bulgaria lost important forest areas. Even if cutting operations were extended, the forest industry of Bulgaria would not be in good condition. The forest areas have been denuded in the last ten years to obtain greater space for agriculture and pasture. The domestic demand for charcoal still depletes the forests.

FIGURE 10.—A primitive charcoal kiln in the Austrian Alps, along the north slope of the High Tauern, Moelltal.

The whole industrial situation is rather unsettled and statistics are mostly estimates, but timber must be imported and in 1925 timber to the value of 2,950,000 lewas was imported from Roumania.

CZECHOSLOVAKIA

Czechoslovakia has inaugurated a forest policy which is a continuation of the forest service of old Austro-Hungary. Czechoslovakia came into being possessed of rich forest resources, which in the days of the old Austrian monarchy were about sixty-five per cent in the hands of the nobility. The percentage of forest area differs within the country, but for the whole area thirty-three per cent is reasonable for comparison with other countries. Within Czechoslovakia the variations are indicated by the fact that in Slovakia the forest still covers thirty-five per cent of the land and in the mountains of Carpato-Russia, the amount is forty-eight per cent of the total area. Forty per cent of the total production of timber is used for fuel, the remainder for industrial purposes. The total production in 1925 amounted to 280,000,000 Czechoslovakian crowns. Thirteen hundred furniture factories and three thousand sawmills employed more than 45,000 workers, and thirty piano factories employed three thousand more. The value of the total production amounted to 110,000,000 gold crowns. Two thousand seventy glass factories used charcoal. Two-thirds of the timber export went to Germany.

DENMARK

Of dominant agricultural character Denmark has only a slight secondary forest industry. The present figure of 7.5 per cent of forested area is no indication of the former wide extent of forests. In the later part of the nineteenth century the Danish government started upon a vigorous reforestation policy by which the sandy heaths and dune areas are being planted with pines and American firs, so that the forest

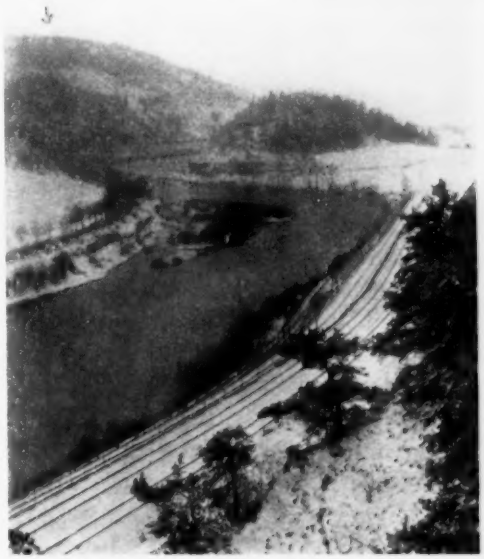

FIGURE 11.—A view of the forests in the Eger Valley of Czechoslovakia.

area is being rapidly increased. Timber must be imported from her Scandinavian neighbors.

ESTHONIA

The glacial soils of Esthonia are thin and infertile. Grasslands and pine forests cover a large area. The forests are in bad condition, resembling second-rate virgin forests. After separation from Russia, Esthonia cut a great deal of her forests to extend her agricultural lands. Time has shown that much of these should have remained in forest but reforestation is proving difficult. Sixty-eight and four-tenths per cent of the forests are controlled by the State. Despite her richness in timber Esthonia has not yet developed a significant forest industry because of lack of labor and power. In 1925 lumber was imported to the value of 26,754,000,000 Esti marks.

FIGURE 12.—Fir growth along the Silesian boundary along Czechoslovakia in the sandstone region of the Waldenburger Mountains

FINLAND

The forest industry of Finland has attained a very high standard. The reserves are tremendous. About sixty-five per cent of the whole country is covered with forests of which nearly forty per cent is first-class timber. The forests in the southern part of the country are privately owned.

In 1905 in the city of Tammerfors one of the biggest paper industries in the world was initiated. The species were as favorable as in Sweden. Unlimited water power was available for a rapid modern development of the pulp and paper industries.

Four hundred fifty sawmills indicate the extent of the industry in Finland. Forest products comprise 80.5 per cent of the total exports. In 1925 Finland exported timber products valued at 4,585,000,000 Finnish marks; lumber, 3,012,000,000 Finnish marks; pulp and paper, 15,037,000,000 Finnish marks; and matches, 34,000,000 Finnish marks. The increase in the value of forest products during the short period from 1923–1925 amounted to 1,234,000,000 Finnish marks.

FRANCE

The main forest districts of France are situated in the Departments of Landes and Gironde in the southwest. In pre-war times, the country was forced to import 1,200,000 tons of timber at a value of 489 million francs. The highly-developed French furniture industry with its center in Paris, using 20,000 employees, will always require the importation of high-grade foreign timber. In the sandy areas of southwestern France, the pine forests supply the turpentine industry with resin. The cork in the Mediterranean Department of Var produces about 110,000 tons in 150 factories at a value of 8.5 millions gold francs. In 1925, 24 factories for pulp and 340 paper mills produced 700,000 tons of paper at a value of 300 million francs.

GERMANY

The German forests are still one of the important factors in the whole

FIGURE 13.—Cork-oaks in the extreme southwest of the Landes replace the pine. The trees shown have been stripped. Note the fern undergrowth. (From "The Landes: Reclaimed Waste Lands of France", W. O. Blanchard, ECONOMIC GEOGRAPHY, Vol. 2, No. 2, p. 254.)

economic situation of the country. They are a valuable reserve, especially if it is recalled that 30.1 per cent belong to the state and are now the property of the people. The prevailing composition of the forest is pine, red and white fir, spruce, and larch, which cover about 74 per cent of the forest land. The remaining areas are of deciduous trees such as oak, beech, birch, and ash. To some extent, the heath and dunes have been reforested so that the present agricultural lands might not be diminished in extent. The northwestern part of the country with its old deltas of glacial rivers has less than eight per cent forest. In the mountains of southwestern Germany, the percentage of forest rises to thirty-eight per cent. The forest service conducted under the care of the state on a scientific basis preserves the standard of the forests; forty-three per cent of the forests are deciduous species such as oak, birch, ash, and beech; the rest are pine, red and white fir, and larch. Special industries are the manufacture of wooden toys, and the use of oak and pine bark for tanning purposes. Special hardwood must be imported for use in the mines and for railways. The countries from which Germany imports timber are Russia, Czechoslovakia, Finland, Austria, Poland, and Sweden. The imports amount to 230 million gold marks and 6,180,000 tons.

GREAT BRITAIN

Great Britain is the only industrialized country of the world that has so little as 4.5 per cent forest area. There is no question that such a situation is detrimental to the economic welfare of the country. The total timber used must come from foreign sources. The imports of 10 million tons are valued at £46,511 for

raw timber for mining and house building purposes, and at £11,109 for paper making material. The imports from English colonies are rather small and of no importance and amounted in 1925 to £266.

GREECE

Until some years ago, the forest land was free to every one. The present government initiated the movement of reforestation, especially in the Peloponnesus. The forest department has estimated the output of resin, charcoal, and cut wood as amounting to 200 million drachmas. In the near future, the new forest service expects an increase in production. The greatest obstacle to reforestation in Greece is doubtless the growing number of goats, estimated at four millions. As in all Mediterranean countries the goats destroy the young trees as fast as they are planted.

HUNGARY

The treaty of Trianon reduced the total area of the country by twenty-nine per cent. The greater part of the Hungarian forests were added by this treaty to Roumania, Czechoslovakia, and Jugoslavia. Now scarcely twelve per cent of the region is covered with forests. Only four per cent of the forests are coniferous. Yet the distribution map of sawmills and paper factories in Hungary shows that these industries have still an important place in the economic status of the country. The fact that timber must be imported to sustain these industries seems rather anomalous, but the reason is found wholly in the change of area by the Great War. In pre-war times, Hungary was surrounded by the mountainous regions which contained great resources of timber. Consequently, the forest industry started. Now the forest border of the country is gone, and the timber and paper industry can persist only by importation of timber from Austria, Jugoslavia, and Russia. Paper mills mostly use spruce and fir wood for raw material and those forests were nearly all lost with the dismemberment of the country. The imports of raw and worked wood amounted in 1925 to 71 million gold crowns.

ITALY

The forest figures for Italy are deceptive. Only the Alps and some parts of Sardinia are forested with beech, chestnut, and oak. The Mediterranean climate prevents a large extent of forest elsewhere in the country. Since most of the bushes of the macchia are included in the forest figures, these figures give a wrong impression and cannot be used for statistical purposes in comparison with other countries. Since the last third of the nineteenth century, Italy has carried on reforestation with the assistance of the government. The reforested area amounts now to 82,900 acres. The import of wood and cork in 1925 surpassed the export by 546 million lire.

JUGOSLAVIA

This country has considerable forest reserves. The largest forest areas are in Bosnia and Herzegovina. There, more than 50 per cent of the whole area is covered with forests which constitute one of the natural resources of this part of the country. Even if economic conditions in the very young country of Jugoslavia are not settled, the figures for forest

utilization show that the forest industry takes first place in its commerce. If Jugoslavia should one day have a real forest service, it should be able to inaugurate and establish one of the important timber industries of the continent. In Slovenia, the old Austria-Hungary government had developed a flourishing lumber industry based on water and bituminous coal. In 1920, in this part of the country, more than 2,000 sawmills existed. The distribution of the forest areas is different in the three sections of the country: Bosnia and Herzegovina, 52 per cent, Croatia, 23 per cent, Slovenia, 15 per cent. Jugoslavia exported timber in 1925 to the value of 16,840 million dinars to Hungary, Austria, Germany, Switzerland, Italy, France, Spain, Portugal, and England.

FIGURE 14.—Forest-clad slopes of the Mosel Valley, Rhineland region.

LATVIA

About one-third of the country is covered with forests. The glacial soils with prevailing sand and heath are adapted chiefly to coniferous species which constitute 79 per cent of the forests. Forest conditions are rather bad. Wood exports decline, as they would not do if a regular forest service were introduced. The use of wood for domestic purposes is very extensive. Wood is used instead of coal for fuel. It is the prevailing material for house building. An intensive forest industry could doubtless increase the production by 25 to 30 per cent. The Latvian timber land produced in 1925 one hundred and twenty million cubic feet of timber and exported one-third of it.

LITHUANIA

The country is so situated that large areas consist of infertile sandy glacial deposits, upon which forests only are profitable. The prevailing rural character of Lithuania leads to a dominance of lumbering and agriculture in the nation's industries. Sixty-two per cent of the forests are

coniferous (35 per cent pines, 27 per cent firs); the rest consists of deciduous species (birches, 11 per cent; alders, 4 per cent; oaks, 1.5 per cent; and mixed forests, 13 per cent). Like other Russian Baltic sections, Lithuania has no coal reserves, and uses wood for domestic purposes. The cut exceeds the growth and there is no real forest service in the country. The work is done by 230 timber factories and companies. In 1925, about 4,290,000 tons cut wood were exported.

LUXEMBURG

This country, where mining is the prevailing industry, uses the forests for that industry. However, Luxemburg must import a small amount of timber.

NETHERLANDS

The Netherlands, a prevailing lowland and agricultural country, is very deficient in forests. The increase in forest area between 1833–1925 was very small. In 1833, the country had five per cent and in 1925 about 7.9 per cent forest area. Even Limburg, the province with the largest forests in the Netherlands, only had a forest area of 17.5 per cent. Timber must be imported and comes from the Baltic States, Russia, Germany and Czechoslovakia. In 1925, the amount of timber imported was 67 million gulden.

NORWAY

Seventy-four per cent of Norway contains unproductive land. Fisheries and forests are the two chief natural sources of wealth. The total forest land is estimated at 21.6 per cent of the country. Pine forests prevail with 75 per cent, and are situated on the eastern slope of the

FIGURE 15.—A pure stand of pines on the North German Lowland, near Potsdam.

Scandinavian highlands. The forest service is very well organized. The water power development in all parts of the country, even in very small communities and in single settlements, is on a high standard. Twenty-nine hundred establishments for cut wood with about 21,000 workers and 46,000 horsepower bring worked wood, wood pulp, and paper on the market. The value of export timber in 1925 was 77,160,000 kronor and for wood pulp, matches, and paper about 263,000,000 kronor.

POLAND

The character of the soil and the climate are the reasons that about 23 per cent of the country is covered with pine forests. The former German provinces of West Prussia, Posen, and Upper Silesia contain about 53.9 per cent of the total forest

land. In the sandy area, the heath, and the glacial ice edge valleys, pines prevail; deciduous trees prevail on the ground moraines. In the western, primarily German, part of the country, a regular service prevented an irrational cut. In other parts of the country, the forest service has just begun. Poland exported in 1925 about 1.5 million tons raw wood and 1.6 million tons worked wood. In 1925 about 2,000 sawmills produced 40,000 tons pulp and 50,000 tons paper. The value of the export amounted to 242 million zlotys.

PORTUGAL

The percentage of forests in Portugal is very small. The variety of tree species is great. Pines cover 47.7 per cent of the total forest area, oaks 22.5 per cent, cork oaks 20.4 per cent, chestnut 5.2 per cent, Pyrenean oaks 4.2 per cent. Timber and cork are great natural resources of the country. In 1925, the export of raw cork amounted to about 176 million pounds valued at 1,241,000 escudos, and wooden planks valued at 1,908,000 escudos.

ROUMANIA

The new political situation in Europe changed the forest conditions of Roumania more than those of any other country. The whole kingdom of Roumania possessed not more than 6,800,000 acres of forest land. Now, the forests cover nearly three times more land. The Carpathians have 75 per cent forests, some of them virgin forest; Bucovina 43.2 per cent; the mountains of Siebenbuergen 30 to 40 per cent; Bessarabia 4 per cent. Leaf-bearing trees predominate (beech, 50 per cent; firs and pines, 24 per cent; oaks, 12 per cent; and mixed foliage-bearing trees, 14 per cent). At the present time, the cultural conditions of Roumania do not permit the expenditure of money to start a regular forest service in the gigantic forest reserves of the Carpathian mountains. These forest reserves will become an important factor in industry when the cultural conditions in Roumania improve in the future. In 1925, 500 factories with about 45,000 workers and 67,000 horsepower took care of the forest production. One-fifth of the production remained in the country; the remainder, amounting to 2,150,000 tons, was exported. The timber exports, valued at 5,360 million lei, is 19 per cent of the total export of the country.

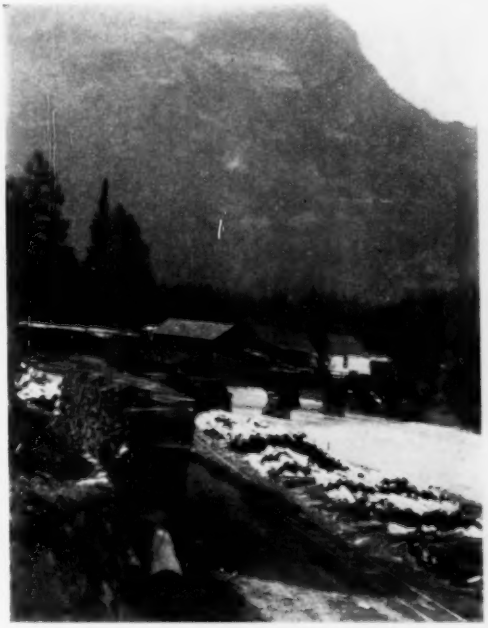

FIGURE 16.—Sawmill along one of the watercourses of the High Tauern, Austrian Alps.

RUSSIA

One-third of European Soviet Russia is covered with forest, the so-called "taiga" or woodland. The country comprises types of all forest

regions of Europe. In the north birches prevail; in the central part fir, larch, and pine; and in the south the leaf-bearing trees such as the alder and poplar. The forest supplies 90 per cent of all the building material and 95 per cent of fuel material. The wood cut amounted to 55,844,000 cubic meters in 1924–1925, of which 32,930,000 cubic meters were used as fuel material. The pulp and paper industry declined rapidly during the last few years. The production of paper fell from 9.1 million pud in 1913 to 4.7 million pud in 1921; the pulp from 2.5 million pud in 1913, to 0.54 million pud in 1921. The administration of 137 factories is now in the hands of the Committee for Paper Industry, under the organization of industries in Soviet Russia based on state ownership and control. At the present time, labor conditions are so unsatisfactory that the Committee could operate only the following mills: paper mills, 97 (32 working); pasteboard factories, 12 (4 working); cellulose, 1 (1 working); pulp factories, 27 (19 working); a total of 137 of which only 57 are working. The export of forest products was 14 per cent of the total export of the country. The timber went to the Netherlands and England. In 1921 the Committee for Utilization of the North Russian Forests (Seweroljess) built 17 big sawmills in the region of Archangel and the Murman coast. The project was to export 1.5 million tons timber per year, mostly to England. In 1925, the whole export of timber amounted to 66 million gold rubles.

SPAIN

This country has a very small forest reserve. The figures for forest are as deceptive as they are for Italy. Macchia prevails. The few forests are situated in the mountains far away from the center of industries. This is the reason Spain imports forest products—in 1923, to the value of 129 million pesetas. Spain has her special forest industry based on cork works and located in the area of the raw material, mostly in the provinces of Gerona and Huelva. The important paper industry of Spain depends on foreign import of raw material, especially from Sweden. About 170 paper mills produce paper for writing, printing, packing, and cigarettes

SWEDEN

The economic welfare of Sweden depends in large part on her timber and wood-working industries. Forests cover 54 8 per cent of the country. The forest industry is worked intensively, owing to the large water power resources of the country. Coniferous trees prevail. In 1925 there were in Sweden about 1,200 sawmills and planing mills with 45,000 workers, 665 factories for joinery and furniture with 12,000 workers; 104 factories for wood pulp and 73 paper and pasteboard mills, together using 35,000 workers. The total exports amounted to 311 million kronor in 1925 for timber, 194 million kronor for wood pulp, 115 million kronor for paper and paper manufactures, and 44 million kronor for matches; all together 49 per cent of the total export of the country. The most important countries to which exports are sent are Great Britain, United States, France, and Germany.

SWITZERLAND

The rich forests of Switzerland were wasted for hundreds of years until the government passed a Fed-

eral forest law to prevent the disturbing of the Federal forests which cover 68.2 per cent of the total forest area of the country. The law of 1876 ordered that these Federal forests should never be disturbed or reduced. Reforestation began at this time and thus caused timber to be imported to Switzerland. The imports come from Jugoslavia, Poland, Czechoslovakia, and France. The amount is rather small, 4,500 tons in 1923–1924 valued at 60 million francs.

FIGURE 17.—An airplane view of the Skutskär Sawmill. One of the numerous sawmills about the head of the Gulf of Bothnia. These Swedish sawmills, built near the mouths of the streams, are placed as far out in the Gulf as the contour of the coast permits, generally on a projecting cape, or a near-shore island. (From "Industrial Sweden," Stockholm, 1924.) (See "Agricultural Regions of Europe," Olof Jonasson, ECONOMIC GEOGRAPHY, Vol. 2, No. 1, p. 29.)

ALBANIA

The 27 per cent of forest land in Albania is undeveloped and must be considered as a future wealth-producing resource. Outside of Albania, only the Bosnian country has so large a forest resource, if we consider the extent of the forest area and the relation of the percentage of the whole country. The forest industry is just starting. Only one sawmill is in operation for the free state of Danzig. Charcoal is produced for home use and for a small export to Greece and Italy. Tar produced from pine wood has only a local importance and raw material for tanning comes from the oak forests. All this, at present, is of no importance in the trade of the country but shows the future possibilities for a better cultural and economic condition.

EUROPEAN TURKEY

The forests, which consist entirely of leaf-bearing trees, had to be estimated. The country has been rapidly deprived of its timber by burn-

ing in order to increase the area of agricultural land and meadows. Charcoal products for domestic use and the large number of goats have decreased the forest area rapidly. The only hope to save the remaining forests is that the 88 per cent which belong to the state will be ably administered. Under better political and cultural conditions Turkey should be able to take care of them.

CONCLUSION

The different supply of the European countries with timber, as well as the different kinds of forest utilization and forest service, have a very good expression in the difference between the excess of growth of or of cut of timber. Even if the figures given by Raphael Zon and William N. Sparhawk[1] are not all up-to-date and must be changed for some countries, they give a general impression of the three groups: where cut exceeds the growth, where growth exceeds the cut, and where the two balance.

This brief outline of the characteristic features of the European forest industry clearly shows how differently the countries take care of this important resource of wealth. The general rule is that the countries with dominant industry and high density of population form a group for which the timber import is characteristic. The others, mostly situated in northern and eastern Europe have a surplus of wood so that they are able to support the first group. The boundary between the two groups is, and it cannot be otherwise, ephemeral. With changing demands of the industrial groups, and changing resources of the producing group, the boundary will fluctuate from time to time.

[1] Forest resources of the world, New York, 1923.

AGRICULTURAL REGIONS OF SOUTH AMERICA

INSTALMENT II

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THE PARANÁ-URUGUAY GRAZING REGION

ALTHOUGH the Paraná-Uruguay Grazing Region, which includes most of Uruguay, three-fourths of Río Grande do Sul, the part of Argentina between the Paraná and the Uruguay—except much of Misiones, northeastern Santa Fé, and southwestern Paraguay, in all an areal extent of 254,000 square miles, presents somewhat varied physical conditions from the rolling, rainy hot lands of the northeast in Río Grande do Sul to the low, level, cooler and drier lands of western Santa Fé, the region as a whole affords essentially similar agricultural activities throughout. Primarily a vast grazing land, its continuity is broken by crop production in only a few scattered places, which form mere specks in a great area of cattle and sheep.

PHYSICAL CONDITIONS

From the bold ranges and broad tablelands of 800 to 1,500 feet elevation of Río Grande do Sul and the ranges of central Paraguay, elevation and relief decrease gradually to the shores of the Río de la Plata, and the swamps of the lower Paraná. Level *mesetas*, high rock ridges, deep valleys, and even rock-strewn surfaces, stone huts, and stone corrals of the north, give way to broad gently undulating, stone-free, grass-covered swells that stretch from horizon to horizon and rise and dip with a ceaseless regularity in smiling folds of land, dotted here and there with the adobe hut of the shepherd and the fence or stake corrals. Rolling surface and a dendritic network of streams, except along the Paraguay and the Paraná, afford excellent drainage, a dry terrain, and in most areas numerous refreshing watering places for the roaming flocks and herds.

Lying between latitudes 35° S. and 25° S. the region constitutes a border zone between temperate and tropical climes; nowhere do freezing temperatures arrest for long periods the growth of grasses; the northwest has never experienced freezing temperatures. Yet the short, mild winters interrupt the great heat of summer as do diurnal changes. Mean summer temperatures range from 72° to 80°; in summer temperatures may reach 110° in the northern part of the region, but usually constant refreshing breezes alleviate the oppressing heat of the summer day.

The rainfall, ample in all areas in usual seasons for a good growth of grasses, increases from 33 inches per year in the southwest to 72 inches in the north and northeast. In the south and west it exhibits a summer and autumn maximum (November to April), while in Río Grande do Sul autumn (March-April-May) is the only period that gets less than 14 inches for that length of time. However, the precipitation varies greatly from the normal in amount and distribution.

Reflecting the amount and distribution of rainfall, the vegetation grades from the grasses of the northern Pampa to the tall grasses interspersed with lines of quebracho trees or solitary palms along the streams and swamps in Paraguay, or individual trees and clumps of Paraná pines or other subtropical trees in the park lands of Southern Brazil. In the south the grasses completely dominate the landscape and include on the ridges mostly bunch grasses belonging to several genera—*Stipa*, *Aristida*, *Andropogon*, *Panicum*, and others; in the swales of the undulating prairie there is a continuous turf of finer grasses and flowering herbs. In Río Grande do Sul much of the open grass land supports both bunch and short grasses of many kinds, but the valleys show a luxuriant sub-tropical vegetation dominantly of trees, including pure stands of *Araucaria Braziliana*. In the northwestern part of the region—in Paraguay and northern Argentina the low hills and ridges, the more dry and sandy areas are covered with a growth of heavy timber, but the lowlands, the grazing areas, many of which are inundated yearly, support early in the season a thick carpet of short grasses followed by a heavy growth of tall grasses, herbs and bushes; scattered tall stately palms dot the landscape and lines of quebracho and other trees along the streams break the continuity of the grassland.

AGRICULTURAL ENTERPRISES

While almost the entire range of temperate and sub-tropical crops can be grown in the Paraná-Uruguay Grazing Region, it is a land of cattle and sheep; the bull and the ram are the lords of the land. In an area of about 254,000 square miles dwell less than four million people, but the pasture lands graze 25.6 million cattle and 25.9 million sheep, nearly 6¼ cattle and 6½ sheep to every human inhabitant of the region, and an average cattle and sheep density of about 100 per square mile.

The dominance of grazing results from favorable physical factors and economic conditions. The mild climate with an annual rainfall of from 33 to 70 inches, though fairly evenly distributed throughout the year, favors the growth of grasses rather than a forest vegetation and permits open range grazing at all times, making large barns and indoor feeding unnecessary. The abundant rainfall and the numerous streams provide an abundant water supply for the thirsty roaming animals, except in certain areas and in exceptionally dry seasons. The somewhat variable temperatures, the less rainy season, and the rather constant breezes alleviate the heat of summer and reduce the trouble from flies and other pests. The rolling, well-drained surface, except along the Paraguay and the Paraná rivers, is excellent for sheep. While alfalfa range is being rapidly extended in Santa Fé and Entre Ríos, it has made no headway in Paraguay, South Brazil, and Uruguay; however, the excellence of native grasses make up in large part in Uruguay and Brazil for the lack of alfalfa. In general, good range land in Uruguay is expected to carry two cows and six sheep to two and one-half acres,[6] but in Paraguay it takes from six to eight acres to support one steer.

On the other hand the region has disadvantages. It is subject to severe and prolonged droughts, when

[6] Harrell, David. The Livestock Industry of Uruguay and Paraguay, United States Department of Agriculture, Special Report, January 22, 1920, p. 2.

the pastures give out and the small streams dry up, causing the animals to perish by the millions. In Uruguay in 1914, 600,000 cattle and 5,000,000 sheep died from starvation and disease following a severe drought; the drought of 1916 caused the death of 1,500,000 cattle. In most years, but especially during dry ones, locusts by the millions swarm south across the country devouring practically all succulent vegetation as they migrate. The northern two-thirds of the region, as a consequence of its hot climate, is infested with the fever tick which bores through the skin of cattle, sucks their blood, infects them with the fever germ, makes necessary expensive preventative measures for cattle moving out of the infected area, and retards greatly the improvement of the herds in this region. The berny fly, a bad pest, and hoof-and-mouth disease, which is endemic, cause considerable loss of flesh and some loss of life every year. It has been estimated that the hoof-and-mouth disease adds from seven months to a year to the time between the birth and the marketable age of a steer. Furthermore, considerable areas overgrazed during the decade following 1910 have grown up in *espartillo* grass and noxious weeds reducing greatly the carrying capacity of the range affected.

Various economic conditions favor the dominance of the grazing industry. The whole area has a sparse population; including towns and cities in the region, the population density figures only 15 per square mile. Most of the people have a strong traditional preference for a free and easy life on the open range. Vast land holdings prevail; in Uruguay all the cattle lands, which include four-fifths of the whole country, are controlled by 31,400 proprietors; in southern Río Grande do Sul the average holding (in ten municipalities) is nearly 75,000 acres; in Entre Ríos in 1914 one company owned eighteen *estancias*, which covered 1,750,000 acres and supported 400,000 head of cattle; in Paraguay vast properties are the rule. These extensive holdings give huge incomes from the sheep or cattle industry without much effort. No economic

FIGURE 26.—The narrow vehicle road alongside the wide roadway set aside in various parts of Uruguay and south Brazil for driving cattle and sheep long distances to railways or market centers. (Courtesy of the Pan American Union.)

pressure, as yet, forces the owner to consider the cultivation of the soil. Furthermore, few immigrants have flocked to this grazing region; the pastoral estates do not make room for them. While it lacks transportation facilities, for a more intensive development, its few railways and its two great waterways—the Uruguay and the Paraná-Paraguay—afford outlets for animals or their products, where the same facilities would be greatly from one section to another. In the southern third of the region many high-grade cattle, especially the Durham breed, have been introduced on the *estancias* of Uruguay, Entre Ríos, and Santa Fé; most of the ranges have been fenced; alfalfa forage provided—only in Argentina; breeding methods improved; and a good water supply provided by wells and windmills. As a result the cattle, when in good flesh at the time of

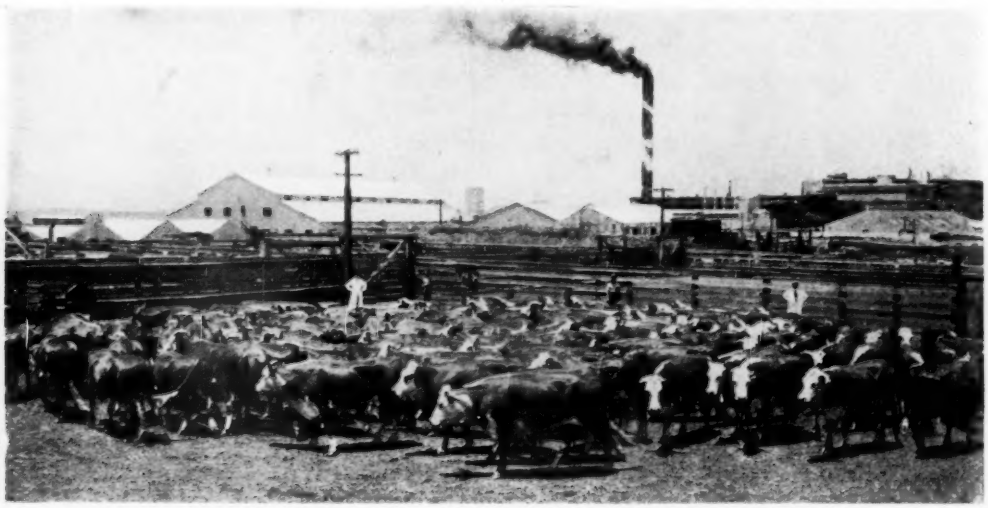

FIGURE 27.—The introduction of pure-bred cattle into southern Uruguay, Entre Ríos and Santa Fé has been a prime factor in the evolution of the trade in hides, extract, and *tasajo* of the old days to frozen and chilled beef of today. Continued improvement will turn more and more of the cattle into first class chilled beef for choice markets. A Packing plant, Montevideo, Uruguay. (Courtesy of the Pan American Union.)

far from adequate for the shipment of farm products (Fig. 26).

CATTLE

The cattle of this region include nearly all of those of Uruguay, one-fourth of those of all Brazil, 29 per cent of those of Argentina, and one-half of those of Paraguay—in all 25.6 million head.

Cattle are present in large numbers in all parts of the region, but the quality of the stock, the kind of care they get, and the products differ market, dress into chilled or high-grade frozen beef (Fig. 27). Yet they rank far below the quality of the cattle of the province of Buenos Aires.

In the northern part of the region most of the cattle consist of the native or *creole* type. They are indiscriminate in color, ranging from a light tan to black-and-white spotted; long and wide of horn, tall and bony, they do not get fat enough to cover the prominent hips and shoulders; consequently they do not make good-grade frozen beef, but only low-grade

frozen beef, *tasajo*, or extract (Fig. 28). Throughout much of this northern section the different ranges of an *estancia* are not fenced, cattle are not separated, and the little effort that has been made to improve the quality of herds by the importation of pure-bred stock has met with little success.

The problem of improving the herds represents a difficult and expensive task. Pure-bred stock brought into the northern area quickly succumb to Texas fever as a result of inoculation by the tick or contract hoof-and-mouth disease or some other disease. While these diseases may not prove fatal, the victim of one becomes practically useless for breeding purposes. However, pedigree stock brought in and kept in the stable under carefully regulated conditions produces a progeny which resists Texas fever better and may be put on pasture. Cattle moving out of the region have to be dipped in an arsenic solution two or more times in order to free them from the ticks. Yet before a marked improvement can take place, the difference between the demands for high-grade meats and the supply must be greater than at present.

FIGURE 28.—Rough low-grade native cattle from northern Argentina, grazing on native grasses on a large island in the Paraná river near Paraná. These cattle even if finished off on alfalfa pasture would not dress into chilled beef because they are large, rough and bony.

SHEEP

While cattle are found throughout the region, sheep do not thrive in Paraguay, northern Corrientes, and Santa Fé, on account of the long season of high temperatures and the low, flat, swampy lands. Even in the rolling lands of southern Brazil, the high temperatures hinder the growth of a heavy fleece of quality wool. The constant importation of breeding stock keeps up the yield and quality of the wool.

The 25.9 million sheep in the region include 52 per cent of all sheep in Brazil (Fig. 29), nearly all those of Uruguay, and 16 per cent of those of Argentina. As in the case of the cattle, the sheep consist chiefly of a rather low-grade animal, descendant of the Merino introduced in early days, although much has been done in the southern area to improve the quality. They are of the wool type in contrast to those of the province of Buenos Aires. Much of the wool

grades low in the world's markets because of only medium quality and of burrs and dirt gathered during droughts. However, the pure-bred and the cross-breed sheep, which have replaced the old inferior type of animal in many sections, yield twice as much wool of higher quality than the old sheep.

FIGURE 29.—The plateau lands of southern Brazil constitute the only portion of that vast Republic which grazes large numbers of sheep because in the hotter regions farther north sheep rapidly degenerate and produce a small amount of low-grade wool. Río Grande do Sul has nearly 56.7 per cent of the total of the country (*Recenseamento do Brazil*, 1920, Volume III (1ª Parte) *Agricultura, Directoria Geral de Estadistica*, Río de Janeiro, 1923).

Unlike cattle, sheep have registered a marked decline in numbers during the past thirteen years—a maximum decline for the region of approximately fifteen million sheep, the greatest being registered in Uruguay and Entre Ríos. The decrease resulted from the great droughts of 1914 and 1916, overstocked ranges, replacement of sheep by cattle in certain areas, selling off low-grade sheep to stock up with better breeds, and the replacement of sheep by crops, especially flax and wheat in Uruguay, Entre Ríos and Santa Fé. Despite this drop the value of the wool and mutton of the region is not greatly below what it was fifteen years ago, because improved methods and better sheep produce more and higher quality products. For a long time this vast area will continue to be primarily a sheep and cattle country on account of inadequate transportation facilities, lack of a labor supply, capital, and equipment for crop production; yet crop production and mixed farming encroach slowly year by year upon the margins of the sheep domain of former years.

CROPS

In many parts of the Paraná-Uruguay Grazing Region a variety of crops breaks the continuity of the pastures. Each extensive *estancia* is self-sufficient, producing most of the products necessary to life—vegetables, subtropical fruits, manioc, potatoes, sugar cane, tobacco, corn, and others. The fact that such a variety of products can be grown imparts permanency to the animal industries of the vast estates; yet the total output is not large owing to the small population. However, some crops assume special significance in certain regions—flax in Entre Ríos and Santa Fé, and wheat and flax in southern Uruguay.

Like wheat, in the Wheat Crescent, flax, in Entre Ríos and Santa Fé, generally breaks the land for alfalfa range, to aid in the improvement of the cattle industry. Flax is especially adapted for a first crop on new land. Its drought and heat-resistant qualities admirably adapt it to this section of the region; it gives high yields; its liability to disease favors its culture on new land. Wealthy land owners wishing to convert native pastures into alfalfa range rent land for two or three years for

the production of flax to immigrant farmers, who at the end of the period leave the land in alfalfa and move on to another *estancia* to repeat the process. This grazing region has one-third of the total flax acreage of the country.

Wheat, another pioneer crop in a grazing land, has become established in central Entre Ríos, in Uruguay for nearly 100 miles north of the Río de la Plata, and in Río Grande do Sul. While the acreage is small and methods of production are primitive and yields per acre are low, fertile, well-drained, rolling lands and a climate favorable for wheat in most respects with the aid of transportation facilities and immigrants will extend the Wheat Crescent around the Corn-Flax region across Entre Ríos to the north of the low flat lands of the lower Paraná and into south central Uruguay. Yet this movement may be slow, for immigrants do not flock to the region and the large *estancias* in this area show little tendency towards being divided.

TRENDS

Nevertheless, for the region as a whole, the decrease in the number of sheep, the improvement of the flocks and the herds, and the introduction of flax, wheat, and other crops, indicate the evolution of a more intensive and valuable type of land use. As roads and railways penetrate the region and as the world's demands for foodstuffs increase, more and more of the sheep and cattle *estancias* will give way to the immigrant, the plow, and crop production.

REGION OF DIFFERENTIATED GRAZING

The most extensive and diverse agricultural region of southern South America consists of the Region of Differentiated Grazing. Although the region includes a variety of physical conditions, the economic activity is everywhere essentially similar. While the Wheat Crescent, the Corn-Flax Region, and the Eastern Pampas Grazing Region are confined to the Pampa, the Region of Differentiated Grazing extends from Pampa to arid mountains, and from cool, rainy, raw Tierra del Fuego to subtropical forest, a latitudinal extent of 32 degrees. In the north the *Monte* of the Sierra de Córdoba and the neighboring mountain slopes graze goats, arid and semi-arid Argentina graze cattle and sheep, and Patagonia-Tierra del Fuego and the Punta Arenas district in Chile graze sheep—everywhere a grazing region. Yet, near the western margin of the area, where water is available, flourish the green oases, the garden spots of western Argentina. This major unit falls naturally into two divisions: the western semi-arid portion, and the south—which includes Patagonia, Tierra del Fuego, and the Punta Arenas area of Chile; the border zone between lies near Río Limay and Río Negro.

THE WESTERN SUB-REGION

In the west the region is definitely limited by aridity and the height of the mountains, but on the east and northeast, its boundaries are elastic. Wheat pushes into it on the east; cattle advance it into the Chaco and the *Monte* as transportation penetrates them; alfalfa has made eastern San Luis a rich cattle country, where arid conditions had been dominant. On the south it grades into the sheep country of Patagonia.

PHYSICAL CONDITIONS

Arid climate, rugged mountain slopes and salt plains, and *Monte* and

sage-brush vegetation exert a controlling influence on the agricultural pursuits of the region.

CLIMATE

Aridity dominates; from 33 inches of annual rainfall in the northeast, the amount decreases rapidly toward the west and south to less than 6 inches. A long dry season, from May to October, prevails over the whole area (Figs. 3–6). The variable winds at times whip the dust of the arid soils into clouds that almost stifle man and beast.

Temperature differences are great; the northern reaches are tropical; the southern lands temperate to cool. The mean annual isotherm of 68° passes through the north and east, and that of 54° the southwest. In contrast to the Pampa, the growing season is determined not so much by temperature but by the distribution of rainfall. With the coming of the summer rains vegetation everywhere springs into life and flourishes; with the return of drought it rapidly dies down, taking on the colors of the desert brown.

RELIEF AND DRAINAGE

In the northeast and the southeast broad plains dominate, in the center the *Monte* covered Sierra de Córdoba for 400 miles lies near the eastern margin of the Grazing region. To the west the surface rises rapidly toward the foothills of the Andes and beyond to the towering ranges and peaks.

Most of the northeast, included in the Chaco, has a flat surface with numerous swamps and a paucity of streams. Only two streams cross it; the Salado, which rises in the Andes in the province of Salta and empties into the Paraná near Santa Fé, and the Dulce, which rises in Tucumán, and waters the oasis by that name, flows to the southeast for nearly 400 miles, and then disappears in the great salt depression bordering *Mar Chiquita*. The Río Salado of the west rises in the province of La Rioja, descends to the southeast and, after being joined by western tributaries, which water the San Juan-Mendoza-San Rafael Oases, disappears in a great marsh in northern La Pampa.

Great salt plains abound in the west central part of the region; the largest of these lies to the west of the Sierra de Córdoba. It covers an area of 7,000 square miles. It is a sterile, arid desert, at rare intervals covered with water which quickly evaporates leaving the soil covered with alkali; it exhibits a total lack of agricultural activity.

SOILS

Soils, in general, are lighter than those of the Pampa to the east. In the Chaco area they consist of silt loam to sandy loams, becoming more sandy in the west. Alkali soils are widespread. Much of western and southwestern Santiago del Estero is a barren desert. In all the mountain sections, the small valleys and the piedmont plains have fertile silt loam to sandy loam soils, but aside from these, light sandy soils of poor quality prevail.

NATURAL VEGETATION

Vegetation everywhere reflects arid conditions. The *Monte* or scrub forest dominates in the north, except in the salt plains without any vegetation and on the mountain tops also devoid of plant growth. The *Monte* occupies various topographic locations and many different kinds of soils. In the east it is quite dense,

but in the west and south it becomes bush-like and grades off into a sage brush formation. The varied trees are characterized by stunted growths, scraggy branching, light crowns, and a wealth of thorns; the more important trees include the *caldén* (*Prosopia algarrobilla*) of slow growth but of great age, the *algarrobo* (*Prosopis campestris*) resembling an apple tree, and the *chañar* (*Gourliea decorticans*), more shrub-like than tree.

In the drier portions small, spiny, low growing, dull gray shrubs dominate. Cacti frequently grow in mats of several acres in extent; in Santiago del Estero, the drier sections are covered by great areas of giant forms of *Opuntia*, which reach a height of 24 feet and a stem diameter of 16 to 20 inches. Of the shrubs in the semi-desert the *Jarilla* (*Larrea cuneata*) is the most common.

With the semi arid trees and shrubs, and the patchy areas of grasses, the region affords scanty pasturage.

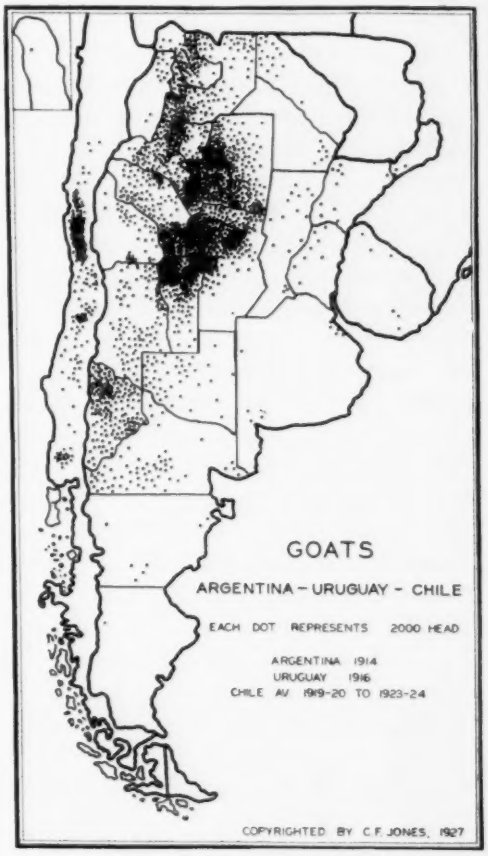

FIGURE 30.—Nearly all the goats of Argentina graze the semi-arid shrub and hilly lands of northern and western Argentina, but they find no place in the agriculture of the irrigated oases and on the salt plains. In Chile they thrive in the more arid portion of the Mediterranean region (Argentina, *Tercer Censo Nacional, Tomo VI, Censo Ganadero* Oficina Estadistica, Buenos Aires; Uruguay, Estadistica Agricola, Año 1916, Ministerio de Industrias, 1917; Chile, *Anuario Estadistico de la Republica de Chile, Tomo VII* Año, 1919–20 to 1924–25, Santiago).

PASTORAL PRODUCTS

Arid climate, salt plain, and scant vegetation combine to restrict almost entirely agricultural activities to that of grazing goats, poor-grade cattle, and wool sheep. However, some dry farming is practiced in the *bañados* of Santiago del Estero.

ANIMALS

Goats, the chief animals of the region, are present in all parts, but are more common on the Sierra de Córdoba and on the outer Cordilleran ranges of La Rioja and Catamarca (Fig. 30). Of the domestic grazing animals, they are best suited to the sparse shrub vegetation and the rugged topography of the land. Likewise they find no place in the agriculture of the irrigated oases of Jujuy, Tucumán, and Mendoza; with an insatiable appetite, they cannot be trusted adjacent to cane fields and vineyards. For want of any food they are absent from the large salt plains.

The animals are not herded in large flocks, but are tended in general in groups of a dozen to seventy-five by individual families of Italians and Spaniards, who are not dis-

inclined towards raising goats (Fig. 31). Of the 4,325,300 goats in Argentina in 1914, this region grazed 3,663,200 of them, or 84 per cent.

Cattle are not abundant, for lack of good pasture; those that are present consist of the bony-long-horn-creole type, good only for *tasajo*, low-grade frozen meat, or draft purposes. Sheep raising is unprofitable in the hot, scrubby pasture areas of the north, but assumes an important rôle in the sage-brush country in the cooler areas of the south. The sheep consist of the Merino, in contrast to the mutton sheep of the Pampa. Nearly all the republic's mules and asses, better adapted to arid pasture and range than the horse, are in this region (Fig. 32).

FIGURE 31.—The *Monte* country of Santiago del Estero in which the raising of goats constitutes the chief industry. A family of Italian or Spanish settlers not averse to goat tending ekes out a bare living in this hot, dry thorn forest country.

Commercial products of the whole region include goat skins, practically the only money product of the goat herders, wool, and mules, the latter being exported on foot over long dreary trails to the highlands of Bolivia for transportation purposes.

THE *Bañados*

Practically the only crop production in the region, outside the irrigated oases, is that in the *bañados*, along the Río Salado, and the Río Dulce. The *bañados*, cultivated plots to which the water of the stream in time of flood is directed by small ridges thrown up, are quite extensive and irregularly distributed. The small plots, *cercos*, are enclosed by thorn hedges to keep out the roaming stock. Corn is the chief crop, although wheat does well. After the crops are harvested, the animals graze on the fields.

THE PATAGONIAN GRAZING SUB-REGION

The Patagonian Sub-region extends from Río Negro on the north to the tip of the island of Tierra del Fuego on the south and includes the Punta Arenas area of Chile; it stretches from the Atlantic to the Andean margin. Over this vast expanse the sheep herder and his dog are the lords of the land; only two small areas, the Colony of the sixteenth of October in the valley of Northwestern Chubut and the irrigated district of the Río Negro, break the continuous area of grazing lands. The region grazes nearly one-fourth of the sheep of Argentina and 43 per cent of those of Chile; it supplies one-half the wool exports of Argentina and four-fifths of those of Chile.

THE PHYSICAL CONDITIONS

Except for a strip at the eastern foot of the Andes and for the southern end, the region is semi-arid to desert. All of central Patagonia re-

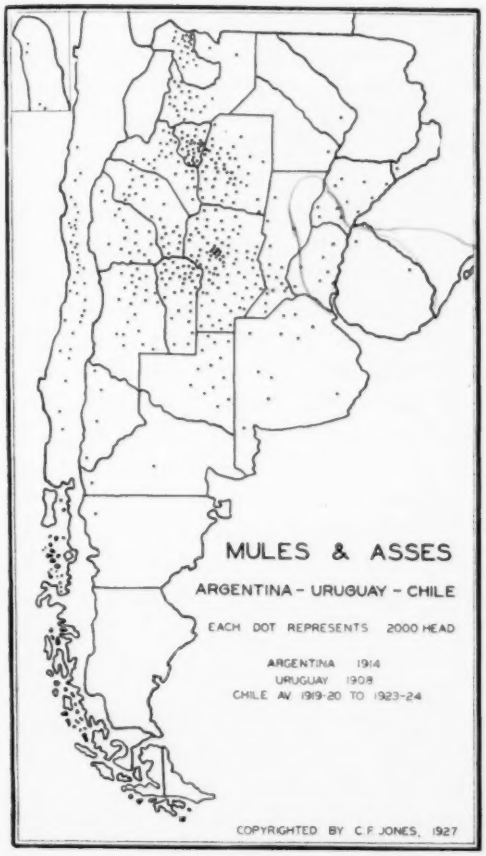

FIGURE 32.—Most of the mules and asses live in the arid and rough section of northern and western Argentina (Argentina, *Tercer Censo Nacional, Tomo VI, Censo Ganadero* Oficinal Estadistica, Buenos Aires; Uruguay, *Estadistica Agricola*, Año 1916, Ministerio de Industrias, 1917; Chile, *Anuario Estadistico de la Republica de Chile, Tomo VII* Año, 1919–20 to 1924–25, Santiago).

ceives less than eight inches of precipitation per year (Fig. 1.). Rain falls only occasionally, and then in heavy showers; cold winters and short cool summers prevail. Constant strong winds whip the dust of the arid surface into clouds, fill the fleece of the flocks with dirt, huddle the sheep together in the lee of some ridge or canyon wall, and drive the few windmills that have been erected over a supply of water. This north central section, a rolling plain of gravel and sand, covered with marshy hollows, cut by east-west valleys and cross ravines and canyons, broken occasionally by short and low ridges, rises in gently graduated levels towards the west. Extensive lava areas of recent origin possess little or no soil and no water, the latter the chief concern of the shepherd. It is a treeless, open plain with a scattered growth of bushes, mostly *Compositae*, *Plantago*, and *Verbena*. These thorny, woody shrubs, from three to nine feet in height, consist of half-dead bundles of crowded twigs and stems. Grass plays a very minor part. Thickets of these woody perennials alternate with nude areas. Many brackish marshes formed in the hollows or where rivers disappear in sand and gravel, support a salt-bush vegetation.

Farther south, in western and southern Patagonia and in Tierra del Fuego different conditions prevail. The low plateau or high plain of central Patagonia continues to the south, a gravel, sandy and clay land, undulating, and broken by low ridges and cut by major east-west streams; it joins with the foothills and the piedmont of the Andes and extends across the Strait of Magellan to the eastern end of Fugia. It receives more rain, from 8 to 18 inches, fairly evenly distributed throughout the year. The lower and more interrupted Andes to the west, and the tapering of the continent allow a free play of oceanic winds over the land, giving a cool, cloudy, moist and windy climate, with much less range of temperature than in the drier area to the north. These conditions, not conducive to tree growth, favor the development of a moorland vegetation. The tall, spiny, thorny shrubs of arid Patagonia give way to (1) the tussocks of the tussock-grass (*Poa flabellata*) which form huge tufts of

well-packed cushions on thick root stocks, (2) the carpet of herbaceous flowering plants, ferns, mosses, and lichens, and (3) the prostrate shrubs and bushes intermingled with (4) nutritious close-set forage grasses.

THE SHEEP INDUSTRY

Climate, vegetation, and isolation combine to give the sheep industry the dominant rôle in the activities of the sub-region (Fig. 33). Very few other animals find a place in the area, except a few horses for riding purposes, a few cows for milk, and steers for draft animals. Few crops can withstand the drought of the north and the low temperatures, small amount of sunshine, and wet conditions of the south. The very restricted cultivated patches consist of the river-oases of the Ríos Negro-Limay and the Chubut, and the small valleys at the foot of the Andes. In this area alfalfa, small grains, and vegetables occupy most of the land. But in the far south, of the cereals, only oats, adapted to cool moist conditions, ripen well.

Because of variations in climate and consequently in vegetation, great contrasts exist between the industry in the north and that in the south. In the former the flocks composed largely of creole type, a descendant of the Spanish Merino, introduced from the north find scant pasturage and a scarcity of water over much of the region. The carrying capacity of the ranges of northern Patagonia averages less than a tenth of that of the native grasses of the Eastern Pampa, about one sheep for every 8 to 10 acres, necessitating a wide ranging of the animals. In some sections transhumance is well developed; the sheep of the plateau move from the winter pastures when the water supply gives out to the lower slopes of the Cordillera for summer ranging. Sheep grazed on these arid pastures yield only a medium quantity of fair-grade wool, which becomes foul with dust and burrs. The location of a permanent supply of fresh water is the chief concern of the herder; in some sections

FIGURE 33.—Wool, the leading sheep product of Argentina, will come more and more from the semi-arid sections of the west and the cool, moist, windy region of the south as sheep are being replaced by cows, swine, and cereals in the Pampa. A sheep range in northern La Pampa.

sheets of water have been tapped by wells, but none exist on the crystalline areas or on the red sandstone district of the central part. On the western margin wells are sunk in the valleys along the track of an underground stream. Along the eastern coast south of Río Negro deep borings have been made; there every ranch has its sheet iron tank and a windmill.

In the area bordering the Strait of Magellan more rain evenly distributed throughout the year provides a good growth of grasses and a good water supply; a light snowfall on the plains permits winter grazing; the low temperatures all year long favor the growth of a fine fiber white wool that easily takes the most delicate dyes; and the strong cold wind, although quite disagreeable to man and beast, aids greatly in drying the damp moors after rains. In addition owing to the wet condition of the surface, covered with vegetation, the wool comes free of dust and burrs. The sheep of this area consist largely of a cross between the Merino, a wool type, and the Romney Marsh, a mutton and wool breed adapted to moist lands; they produce good mutton and shear a heavy clip—5 to 9 pounds. Near the refrigeration plants some Lincolns are being introduced. However, the region has its handicaps; in a cold, damp storm of winter many sheep may perish; it is a common practice for shepherds to go over the ranch to remove the pelts from the animals that perished during the winter. Scab is an ever-present menace; sheep must be dipped several times a year.

Practically all the good range land has been parcelled out in vast *estancias*, to individuals in some cases but to large corporations in others. Many holdings embrace more than 2 million acres; one in the Punta Arenas district of Chile, valued at 7 million dollars grazes 1,200,000 sheep, 20,000 cattle, and 9,000 horses, shears more than a million head per year, and produces vast quantities of mutton. In Southern Chile, of 167 land holdings, 37 per cent embrace more than 12,350 acres. Vast areas under one management are required to provide ample water supply at all seasons, and winter and summer range. On these large stretches the sheep, tended by a shepherd and his dog, migrate over the range, returning periodically for dipping and shearing to the ranch headquarters, usually located where water and pasture are most abundant. Most of the large land holdings are in the hands of the British or the landed class of Argentina, while the herders are preponderantly Scotchmen, Welsh, Germans, half-breeds, and Falklanders, many of whom come on five-year contracts to work for the companies; they receive a house, fuel, meat, and 30 to 40 dollars per month.

Wool, the chief product of the Patagonian Sub-region, sheared from November to May, moves by convoys of wagons to the ports on the coast. Since 1895, when the first slaughtering plant was built on the Strait of Magellan to use up the old sheep no longer productive, large freezing plants have been erected at Puerto Gallegos, San Julian, and Puerto Deseado. Following the shearing season the surplus sheep move in great numbers to the slaughtering plants on the coast.

TRENDS

Aridity in the northern portion and the short growing season with low temperatures in the south preclude a

marked production of crops. Complete isolation, lack of great resources to foster a significant development of rail transportation, and the adaptation of sheep to the region indicate that activities will continue along present lines—the herding of large flocks of sheep over vast, open, windswept spaces. While the numbers of sheep have increased by two and one-half million in the whole region since 1914, a continued expansion is not to be expected; the region now grazes about 15 million sheep. Many ranges are stocked to capacity; others have been overgrazed. Yet with better provision for water, some protection from cold winter storms, fenced ranges, and better methods of breeding, the region can continue to supply 120 million pounds of wool or more annually for the chief manufacturing nations.

THE IRRIGATED OASES OF WESTERN ARGENTINA

From the irrigated *vegas* of the Patagonian Andes through the great Oases of Mendoza and Tucumán to the fertile valleys of Jujuy are many gradations—from temperate fruits and pasture to grapes, sugar, and tropical fruits. Yet, each and every area exhibits one controlling characteristic—agriculture by irrigation.

THE SAN RAFAEL-MENDOZA-SAN JUAN OASIS

In the oases of the provinces of Mendoza and San Juan the dominant agricultural life consists of the cultivation of the vine and the preparation of wine. The region extends from south-central Mendoza to a corresponding position in San Juan. Although the agriculture of the region depends entirely upon irrigation, the three districts—San Rafael, Mendoza, and San Juan—do not form a co-extensive oasis (Fig. 34).

PHYSICAL CONDITIONS AND IRRIGATION

Aridity in the region and the precipitation, chiefly snowfall, on the high mountain masses to the west, from which issue the life-giving waters, constitute the chief basis of the oasis agriculture. The intense aridity prevents the development of cryptogamic diseases and allows harvesting to continue for two months, necessitating only a small labor supply. The quite severe winters also favor the control of diseases and insect pests of the vine. Late frosts in spring and hot winds in summer (the *zonda*) wreak havoc; hail frequently causes great damage over small areas at the mouths of the valleys. Yet, on the whole, conditions are almost ideal for viticulture.

Since there are few gaps in the lower slopes of the Cordillera, water becomes available at only a few places. Río San Juan supplies the water for the San Juan oasis; the Mendoza, the Tunuyán, and their tributaries for the Mendoza district; and the Diamante and the Atuel to San Rafael. In all areas dangers of floods exist for the rapid melting of snows on the mountains creates rushing torrents.

The vineyards are all located on alluvial fans where the streams emerge from the outer ranges of the Cordillera. Gently sloping fans or piedmont plains facilitate the easy distribution of water to large areas of light, fine, silt loam soils of a few inches to several feet in depth, overlying a porous gravel into which the roots of the water-seeking vines penetrate. The A and B soil horizons have a high lime, phosphate, and

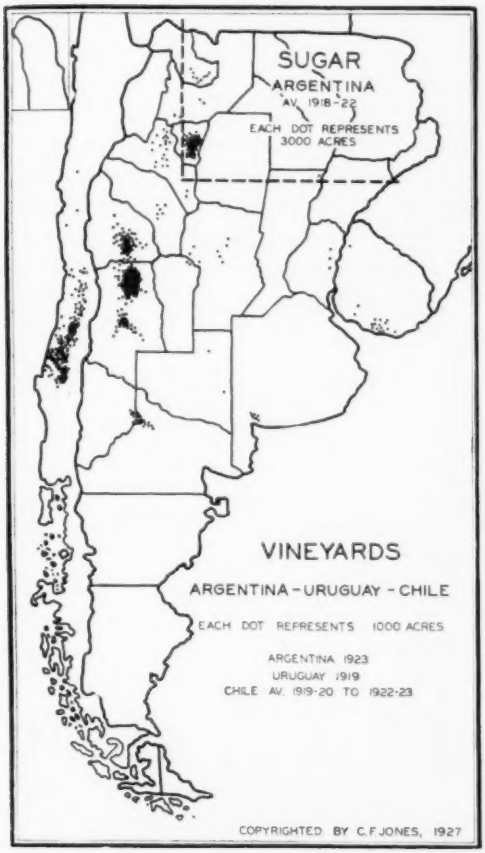

FIGURE 34.—The San Rafael-Mendoza-San Juan Oasis has 77 per cent of the total Argentine acreage of grapes. In Chile grape culture is confined largely to the Mediterranean Region, chiefly the central valley. The Tucumán Oasis has most of the sugar acreage of Argentina (Vineyard acreage—Argentina, *Anuario de la Dirección General de Estadistica, de la Province de Mendoza*, 1923; Chile, *Anuario Estadistico de la Republica de Chile, Tomo VII, Argicultura, Año* 1919–20 to 1924–25; Uruguay, *Anuario Estadistico*, Director General de Estadistica, Montevideo, 1921.

potash content, but nitrogen and humus are scarce. Supplementing the irrigated areas are some cultivated lands, not requiring the application of water, situated on the outer margin of the alluvial fans at Mendoza and San Juan. When drained, a fine black fertile soil returns abundant yields.

While the irrigated areas of San Juan and San Rafael are evenly distributed upon the surface of the alluvial land, that of Mendoza consists of a strip along the Tunuyán. Water rights are not owned independently of the soil. Concessions are assigned to specified estates and in stipulated amounts, according to the cultivated area. At low water, the turn system with a period of 8, 10, or 12 days is enforced.

AGRICULTURAL PRODUCTS

Just as Patagonia connotes sheep and wool, Mendoza signifies grapes and wine, and to a lesser extent alfalfa. Of 306,700 acres of vineyards in Argentina in 1923, the San Rafael-Mendoza-San Juan Oasis had 235,500 or 77 per cent—Mendoza, 152,000, San Juan, 54,900, San Rafael, 28,600.

The three portions of the oasis differ economically rather than physically—Mendoza represents the most advanced area; San Juan, an area in which methods are being modernized; and San Rafael, a new development. The *creole* vine, originally from the Canary Islands via Peru, gave Mendoza its early importance; while it has disappeared from that area, it still survives in San Juan. It gives high yields of sugary rough grapes of poor quality for the manufacture of wine. In the two southern areas new French varieties grafted on phylloxera-resistant stocks occupy most of the vineyards. They are trained on wire and pruned low, which is inexpensive and facilitates cultivation, ripening, and harvesting.

Most of the land is held in large estates on which the immigrant, colonist, or native laborer tends a selected portion of the vineyard or works on contract labor at a specified price (Fig. 35). The land-owner furnishes all supplies, including animals and equipment. The producers consist of two types—*viñatero*, one who grows

the grapes only, and the *bodeguero*, one who grows grapes and makes wine, or one who only makes wine. The *viñatero*, who must sell to the wine manufacturer, has to deal at the latter's terms. The *bodeguero* sets the time for harvesting the grapes, the price to be paid, and the date of delivery.

A modern *bodega* represents a large investment. One at Mendoza has 41 compartments for aging wine, 20 vats of 100,000 gallons each and many smaller vats with a capacity of one million gallons, 182 railway cars for the transportation of grapes from the vineyards, 93 tank cars for shipping cheap wines, expensive machinery operated by electricity, barrel manufacturing department, large stables for hundreds of mules and steers used on the estate, and long rows of houses inhabited by the laborers.

Although in season the consumption of fresh grapes is large, the bulk of the crop goes for the manufacture of wine. However, the use of table grapes increases, especially for the export trade. In 1925, 4,300,000 pounds of grapes were exported.

The average per capita consumption of wine in Argentina approximates 14 gallons per year. In supplying the major markets of the country, 2,460 plants produced 140 million gallons in 1926. Of this total 1,330 plants in the San Rafael-Mendoza-San Juan Oasis produced 96 per cent. While the *bodegas* make both high- and low-grade wines, the bulk of the output consists of either *vino blanco* or *vino tinto* of the latter type.

OTHER PRODUCTS OF THE OASIS

In area, alfalfa surpasses vineyards in the province of Mendoza. Of the cultivated land, 46 per cent grows alfalfa and only 28 per cent the vine, the chief source of wealth. Corn ranks third in area, potatoes fourth, and fruits fifth. San Rafael produces a big share of the alfalfa seed of the country and much of the exportable surplus. Cattle—dairy, draft, beef—and mules constitute essential equipment of every oasis; San Rafael grazes fine Durham and Hereford cattle on alfalfa range for export to Chile.

FIGURE 35.—Arizu vineyard at harvest time—Mendoza Region.

TRENDS

While climatic conditions are almost ideal, considerable water flows on unutilized, and much is wasted on

roads, gardens, trees, or seepage, areas of fertile soil remain untilled, and irrigation projects are under development, no great expansion in vine culture is to be expected soon, for overproduction and marketing have become the chief concerns of the region during the past few years. The oasis may grow other things, but under present conditions wine gives the best success and the most profit.

THE TUCUMÁN OASIS

In contrast to the Mendoza Region, the Tucumán oasis is a land of sugar, rice, and tropical fruits. What Mendoza is to the country for spirits, Tucumán is for sweets. It lies in the eastern part of the province of that name, at the western edge of the *Chaco-Monte* country and at the foot of the *Sierra de Anconquija*.

PHYSICAL CONDITIONS AND IRRIGATION

Climatic conditions differ greatly from those at Mendoza. Tucumán, in the center of the oasis, receives 37.8 inches of rainfall per year, with a marked summer maximum; however, since water is available and irrigation gives better results, irrigation prevails for cane. A moist area bordered by *Monte* and thorn forest on the east and south, spiny shrubs in the valleys and resinous *tala* of the *Puna* on the west, and Chaco forest on the north, it has uniformly high temperatures and a great deal of sunshine. The average range between the mean temperatures of any two months of the three seasons other than winter is only 17°. High humidity and mists over the area render the danger from frost uncommon; abandoned plantations 35 miles from the Sierra indicate the extent of the frost-free zone. But the region has its climatic handicaps; as a result of frosts, cane must ripen in less than a year; early frosts occasionally force the grinding of cane before it reaches maturity; some seasons the cane suffers from lack of rainfall.

Numerous streams descend the eastern flank of the Sierra, spread out over the great piedmont alluvial plain consisting of fine silt loam soils of high potash content overlying sand and gravel, and later join the Río Sali and Río Dulce near the outer margin of the plain and the oasis. Being in small usable units, these streams afford irrigation water without the construction of enormous dams.

SUGAR

From this region, not more than 55 miles wide and 100 miles long, comes 84 per cent of the sugar output of Argentina. Sugar occupies (1921) 52 per cent of the cultivated land of the region (Fig. 34). Owing chiefly to climatic conditions and to diseases the cane does not contain a high sugar content. Old variegated and purple types have been replaced largely by disease-resistant varieties from Java.

In general, the large refineries of the region grow much of the cane, with paid workers or contract renters; but they also purchase that of independent cultivators, who work their own lands (Fig. 36). As much as one-half of the cane harvested moves by rail to the centrals. During the harvest season of May and June a large labor supply must be recruited from neighboring regions.

The production of sugar varies greatly from year to year, owing to frosts, droughts, and diseases, causing a constant adjustment of the tariff schedules on sugar. In years

FIGURE 36.—A large sugar estate on the piedmont alluvial plain in the Tucumán Region. The small houses are the homes of the tenants.

of large output high tariffs are necessary to maintain profitable prices, but during years of low production, imports become necessary to satisfy the home demand.

OTHER PRODUCTS OF THE OASIS

Corn ranks next to sugar—it occupies 27 per cent of the land in crops, it supplies much food for the people and feed for cattle—cows, draft, beef—and mules. In contrast to sugar, it grows without irrigation. Alfalfa and rice are important crops, the former for range, hay, and as a fertilizer crop, as the yields of sugar decrease rapidly if the land receives no fertilizer. Fruits—*avocados*, pineapples, and grapes—and vegetables are produced.

THE OASIS OF JUJUY

About 200 miles to the north of Tucumán lies the Oasis of Jujuy, which ranks next to the former as a sugar producer. It forms a crescent-shaped area along Río Jujuy in the southern part of the province. It has deep rich alluvial soils; it seldom has frosts. Yields are greater, and the sugar content is higher than in Tucumán.

Each sugar estate is a large clearing in the forest. Workers are lodged and fed by the factory owners; most of the labor has to be brought in from the outside. The harvest labor consists largely of Chaco Indians; some 6,000 temporary immigrants arrive each year between March and June; occasionally whole tribes migrate.

The whole oasis produces only about 20,000 tons of sugar per year. While it may have some advantages, a small labor supply, little capital, long distance of transport for all supplies, and the small size of the alluvial plains in contiguous areas retard development.

In Jujuy, as in many small irrigated areas at the mouths of *quebradas* where alluvial cones afford fine soil and easily watered lands, grapes, alfalfa, corn, and vegetables are produced, and animals are raised for sale in the mining regions of Bolivia and Chile. They are scattered from Jujuy on the north, through Salta and

La Rioja to the *vegas* of Neuquén and the Río Negro Oasis.

RÍO NEGRO OASIS

Near the confluence of Río Limay and Río Neuquén stretches for sixty miles a narrow but promising oasis. It has a fine clay loam soil, short hot summers, mild winters, much sunshine, and strong spring and summer winds. Grapes are most important, but apples, peaches, wheat, barley, and vegetables do well. Alfalfa, for transient stock ranges, occupies much of the land. In contrast to the great oases to the north, land is parcelled out by the National government in squares of 250 acres, under a ruling that within two years the land must be fenced, a poplar wind-break planted, and a house built. Limited by a water supply and available land, it will remain only a garden strip in a vast grazing region.

SOUTH ANDEAN GRAZING REGION

The South Andean Grazing Region extends from about 37° S. latitude to the sheep region near Punta Arenas; it includes the Andes from the eastern foothills in Patagonia to the heavily forested windward western slopes in Chile. Dominated by remoteness, rugged mountainous relief, and low temperatures, agricultural activity on the whole consists of grazing, although fairly fertile sheltered valleys in the northern portion give rise to many tilled patches, or *vegas*.

From the standpoint of relief the region discourages agriculture. The summit altitudes decrease from the highest in the continent, a short distance north of the area (Aconcagua, 22,812 feet) to six or seven thousand feet in the southern portion. High snow-capped or glacier-covered peaks and ranges, deep valleys, and large, picturesque glacial lakes cover much of the area; little level land exists in any part; and numerous broad open passes at comparatively low elevations, three thousand to six thousand feet, break the continuity so characteristic of the Cordillera farther north.

Climatically, the region represents a transition zone from semi-arid Patagonia to the rain-drenched Chilean littoral. The annual precipitation increases from 12 inches on the east to 50 or more on the west; a similar increase exists from north to south. On the whole, low temperatures prevail as a result of considerable altitude and high latitude. In the sheltered valleys of the north, the mean annual temperatures are about 50° F.; in the far south, 41° F. The mean winter temperature at *16 de Octubre*, in the largest agricultural section of the region, is 36°; in southwestern Santa Cruz, 32° and less. The summers, although warm, are not free from frosts; despite its favorable location, *16 de Octubre* has experienced killing frosts in every month of the year.

Much of the region supports a forest vegetation. Both flanks of the Andes are forested up to an elevation of approximately 4,000 feet; above that, Alpine vegetation and tundra dominate. In the north, 37° 20′ S. to 39° 40′ S., the Chilean or Andean pine (*Araucaria imbricata*) occurs in almost pure stands; *alerce* (*Fitzroya patagonica*) grows chiefly in swamps and in sheltered valleys. South of Lake Nahuel Huapí, the pine-beech-cedar forest contains several species of beeches—*coihué*, *Notofragus dombeyi*, an evergreen, most numerous of all trees; *lenga*, *N. pumilio*, at higher elevations; *ñirre*, *N. antarctica*, in swamp and on gravel beds and burned

over lands—*ciprés* (*Libocedrus chilensis*), and *canelo* (*Drimys Winteri*), a valuable hardwood.

Although forests clothe a considerable portion of the region, they have induced little development. Large areas have been burned; the proportion of old unsound trees is estimated to range from 60 to 80 per cent in the heavy stands of *coihué* and *lenga*, and 50 per cent in the *ciprés* areas. Remoteness from shipping facilities has hindered operations; even with railroads, the Andean forests offer little inducement for investments of capital. Lumbering in the mountains requires a large initial outlay, a great running expense, and costly transportation in the forest—the *coihué* sinks in water, no large pure stands of any one tree occur, and the short wood fibers are not of great value.

For forage several growths are utilized. Bordering the tableland on the east are the *serranías*, areas supporting hard grasses and shrubs which provide extensive grazing. In the forests cattle feed on underbrush, bamboo, and succulent grasses that grow in the shade. On burned-over areas, grasses become more abundant and the wild pea vine grows luxuriantly.

The entire region, with a maximum of rugged area, a paucity of arable land, low temperature, a forest cover dominating, and extremely remote, consists for the most part of an undeveloped land. From an agricultural point of view grazing is the principal activity, although crop production exists in the northeastern portion.

Cattle grazing and breeding are practiced by *pobladores* on public lands, and by ranchers on regular concessions which they have fenced. The high Alpine pastures, above the forests, are utilized as summer range from December to March while the forest serves throughout the year. Below 3,500 feet clumps of bamboo in the undergrowth provide shelter and fodder not covered by the heavy snows. The grassy *serranías* are not suitable for winter pasturage because of strong winds, but tufted grasses in many open valleys near lakes or streams graze flourishing herds. The *serranías*, where running water is available in summer, are eagerly sought.

Sheep herding is less important than cattle grazing for the forested areas are unfavorable for their best development; they graze on the more arid *serranías* and on the Alpine pastures to which they can migrate during the summer across the forest belt along some open valley. A few thousand goats crop their precarious living on the slopes of the eastern, more arid portions of the region in western Neuquén and Río Negro.

In the more salubrious portions of the region, principally about the head waters of Río Chubut and Río Limay, small fertile valleys or *vegas* are cultivated. The most important of these areas is the *16 de Octubre* where some 69,000 acres are available for cultivation. This district settled by Welsh farmers about thirty years ago produces wheat, rye, and potatoes used to support the local pastoral population or sent some distances in the Patagonian region. Of necessity most of the land is given over to wheat for the remoteness of the region restricts the importation of breadstuffs. A variety of garden vegetables of temperate climates is produced. Many fruits—apples, plums, pears, cherries, and peaches—are grown successfully; grapes, if provided with winter cover, do fairly

well. The isolation of the various fertile valleys, poor methods of transportation, and the dangers from frost have prevented a large-scale production for export.

On the whole, the South Andean Grazing Region has relatively few animals and a very sparse population. The largest towns in the area have only a few thousand people; yet the lonely shepherds' huts tucked away in the remote little valleys show that the better range lands have been spotted and are being grazed.

PACIFIC TEMPERATE FOREST

The windward slopes of the coastal mountains south of 37½° S. and the intermediate and lower slopes of the Andes south of 34° S. support a Pacific Temperate Forest. Extremely rugged and stony, rain-drenched, cold, and cloudy, this region is almost entirely devoid of pastoral and farming activities.

Except for the moderately rough coastal ranges and the steep slope of the western flank of the Andes adjacent to the central valley, a fringe of islands and peninsulas, separated by deep fiords and intricately winding channels and rising abruptly from the sea to precipitous heights within short distances from the water's edge, occupies most of the area in the long stretch of almost one thousand miles from Puerto Montt to the southernmost tip of Tierra del Fuego. Few disconnected strips of lowlands exist. From the glaciers and snowfields of the high Andes, numerous sparkling and rushing streams in deep valleys plunge into the cold waters of the fiords. The cold waters of the South Pacific, lapped and churned by the strong and constant western winds, pound against the bold headlands. These strong moist winds from the west, on moving over the land throughout the year, yield on the lower slopes copious rains and on the higher parts deep snows, which feed the streams and glaciers. In addition prevailing cloudiness and low temperatures preclude the production of crops and likewise a good growth of grasses. Only in the northern forest is grazing during the summer profitable. Consequently, forests dominate.

Since the region has a large extent in latitude and altitude a variety of trees thrives. On the intermediate slopes of the Andes, extending from three thousand to five thousand feet altitude to the east of the central valley, are forests of *Araucaria imbricata*, the Chilean pine. Open stands occur mixed with *roble* (*Nothofagus oblequa*), *coihué* (*N. dombeyi*), *rauli* (*N. procera*), and other species. At higher altitudes where these species do not extend except in stunted shrubby form, *Araucaria* grows in pure stands. Beyond the merchantable timber are dense stands of shrub-like *ñirre* (*N. pumilio*) and other scrubby growths. In the coastal strip south of Valdivia and on the islands and headlands south of Puerto Montt to 47° S., several beeches dominate, *coihué* and *roble* comprising nearly half the stand. Associated with the beeches, *ciprés* or *cedro* is fairly common in the mountains and in some localities in the lowland, and *alerce* (*Fitzroya patagonica*) occurs chiefly in low swampy or bog areas. Throughout this section valuable commercial timber stands in the lowlands and on the mountains to 4,000 feet. While the beeches, the *cedro*, and other species extend far south to almost the tip of the continent, covering much of this district, a small part of the timber has

any commercial value. Trees gradually become smaller and more stunted toward the south, until at the Straits of Magellan much of the forest is little more than shrub formation; it extends not higher than 1,900 feet in the southern part.

Although the northern portion of the region has valuable timber, lumbering operations are only beginning, for the forests of the southern end of the central valley and the eastern half of Chiloé have supplied the required lumber as the land has been made ready for settlements. To the east of the central valley the forests are of special value in storing up the flood waters and in retarding the melting of the snows, thus preventing floods in the valley and furnishing water for irrigation.

The entire Pacific Temperate Forest is one of a very sparse population; it has less than one per cent of the inhabitants of the country, who consist for the most part of primitive and semi-civilized tribes of forest Indians and fisher folk, some of whom still live the life of the Stone Age. From an agricultural point of view it holds little promise; except for the part of the region adjacent to the central valley, it will continue for an indefinite period to be a forested region with only a sprinkling of primitive Indians.

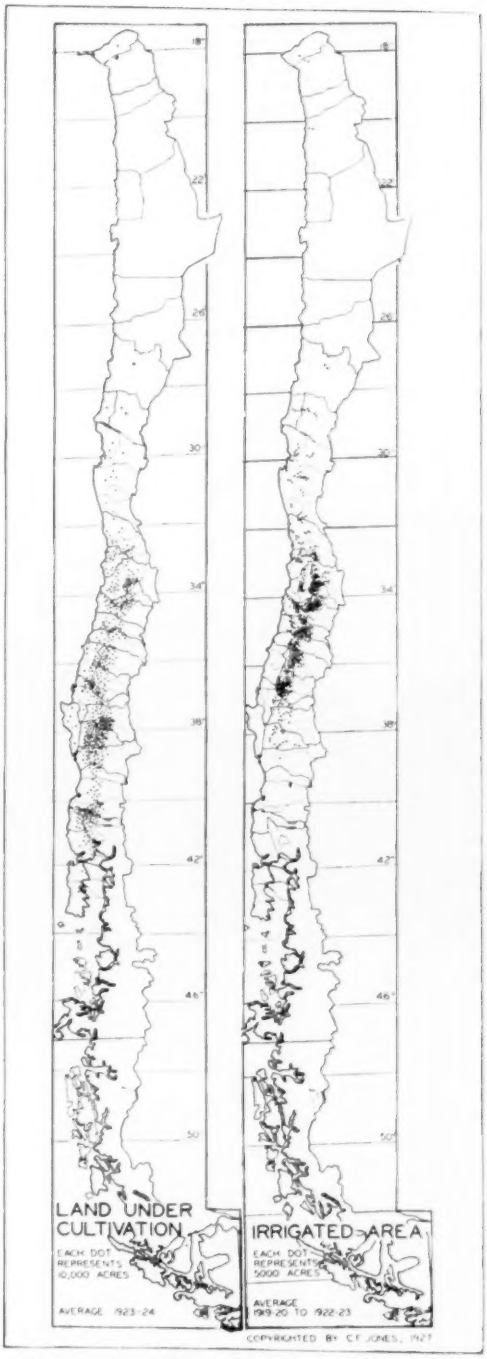

FIGURE 37.—The land under cultivation and the irrigated area emphasize the importance of the central valley and the Mediterranean coastal district area of Chile.

HUMID PASTURE-CROP-FOREST REGION

Between the two northern strips of the Pacific Temperate Forest, the Humid Pasture-Crop-Forest Region occupies the southern third of the central valley and the eastern part of Chiloé. The eastern and western boundary zones extend along the margin of the Andes and the Coastal Ranges where forests almost entirely dominate the landscape and beyond which conditions of relief, climate,

soil, and economic activity combine to preclude crop production on a significant scale. The northern boundary, 38° to 39° S., marks the southern extent of irrigation in the valley (Fig. 37).[2] As a whole, the region is characterized by the production of temperate crops, with livestock farming conspicuous in the vicinity of the large towns, and by the amount of land in forest. Of a total area of about nine million acres, 14 per cent is in crops.

Through the broad breaks in the coastal ranges and over their low summits the moist western winds give abundant rainfall and a high percentage of cloudiness and relative humidity to the region of mild winters and cool summers. The mean winter temperature for Ancud, Chiloé, near the southern end of the region is 50° and the mean summer temperature 57°; those at the northern end of the region are 50° and 61° respectively. From the northern margin the annual rainfall increases from 30 inches to more than 75 at the southern end of the valley. Although a winter maximum prevails some rain every month during the summer assures agriculture without irrigation. In contrast to the area to the north the serious problem here is not insufficient precipitation, but too much moisture and too little sunshine.

FIGURE 38.—Burning forests in the southern end of the central valley usually constitutes the first step in the preparation of the land for pasture or crops, the most wasteful method that can be used so far as lumber is concerned, but forests are plentiful and land is cheap and labor expensive.

The level to gently rolling valley floor dipping slightly to the south composed chiefly of sedimentary materials derived from the bordering mountain masses has characteristically a relatively fertile gray forest soil. Many rivers from the high Andes cross the valley and enter the sea through breaks in the Coastal Range; large lakes in the southern part occupy considerable areas.

THE USE OF THE LAND

Originally covered with a valuable pine-beech-cedar forest, extensive

[2] The statistics for all the Chilean maps were compiled, with the assistance of Mrs. Harley P. Milstead, from the *Anuario Estadístico de la República de Chile, Agricultura, Tomo VII, Año* 1919–1920 to 1924–1925, Santiago, Chile. The writer is indebted to Miss Edna Gueffroy for the preparation of the maps and for assistance in the delineation of the agricultural regions of Chile.

areas have been burned to give place to productive farms (Fig. 38). Nearly one and one-half million acres are in crops, including hay crops; most of the remainder still supports forest although much of it is used as woodland pasture. The southern part of the region constitutes frontier land; agricultural development is just getting under way.

CROPS

The cool summer and mild winter climate, with a fairly long growing season, abundant precipitation relatively well distributed throughout the year, the fertile soil, and the gentle relief favor the production of the more hardy cereals, vegetables, and fruits. Wheat, oats, and potatoes assume special significance.

Wheat, first in importance in acreage of land devoted to it, occupies 35 per cent of the land in crops (1919–1923); also 35 per cent of the wheat area in the country is in this region (1919–1923), chiefly in the northern two-thirds as the more rainy humid summers of the south discourage somewhat its harvesting. Soft white small wheats and other varieties, *Linaza* and *Mocha*, which resist moisture and rusts, are grown. Wheat is nearly always the first crop on new clearings, burned over during the driest part of the summer. Without much preparation of the land, sowing takes place in May, June, and July, the months of maximum rainfall; harvesting begins at the end of December. The virgin soil covered with ashes usually gives high yields. In the southern part harvests are uncertain as rains and cloudiness prevent the ripening of the crop (Fig. 39).

Although the potato is one of the most widely grown crops in Chile, more than half the acreage is in the Humid Pasture-Crop-Forest Region, chiefly in the southern part, where a moist, cool climate and friable, loose soils favor its cultivation, but hinder the production of others, forcing a more complete dependence of the people on this crop for a food supply (Fig. 39). Many varieties of potatoes give good yields in this region, 150 bushels per acre as compared with 130 bushels for all Chile. After the ground is broken with a crude plow, potatoes are planted in rows from eighteen inches to three feet apart, and covered by a split log dragged along the row. In general they get one cultivation with spade or hoe when about four inches high. Most of the crop is consumed for food, but some is fed to cattle.

Almost 80 per cent of the acreage devoted to oats in all Chile is in this region, chiefly near the northern margin (Fig. 40). Oats are better adapted to cool, moist conditions than most other cereals, and they take the place of corn, not produced in this region, as feed for horses and work oxen. In addition, a considerable surplus remains for export, most of which goes to England.

Field peas are grown to a considerable extent in the southern region; they form a more staple crop than any of the other legumes. Commonly they follow potatoes and wheat. Sowing takes place in September or October, as soon as the danger of killing frost is over. They are harvested with a sickle and threshed with horses. They form an important part of the diet of the lower classes, being eaten as a thick soup.

Most of the temperate fruits are grown, but the apple which vies with the grape and peach as the most popular fruit in Chile finds favorable

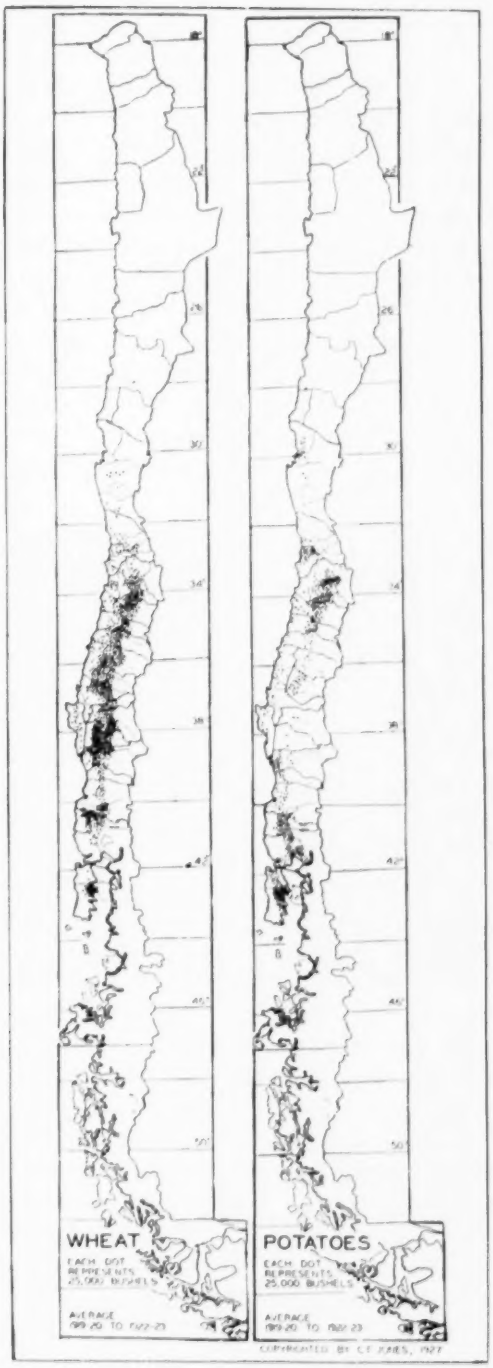

FIGURE 39.—Wheat and potatoes, both important food crops, are produced throughout the agricultural area of all Central Chile, although wheat begins to drop out near the southern end of the central valley, owing to cloudiness and high rainfall at harvest time.

conditions in this moist cool region close to large consuming districts. Early introduced by the Jesuits, it was soon spread by them and the Indians quite generally between 38° and 41° S. The bulk of the output comes from small farm orchards or solitary trees scattered through fields and woodland pasture. The orchards or trees get little care anywhere. The fruit is consumed by all classes in the fresh and dried form; it also serves to make *chicha*, a boiled and usually semi-fermented cider.

Hay, including crimson and white clover, vetch, and marsh grasses, ranks next to oats in acreage among the cultivated forage crops of the region. But small open grasslands and woodland pastures supply most of the forage for livestock.

ANIMALS

Cattle, horses, sheep, and swine find a place in the system of farming throughout the region. In contrast to the Pampa of Argentina and Uruguay, no enormous herds exist; every farm has a few animals and some have considerable herds and flocks.

This small area holds nearly two-fifths of all the cattle in Chile. Descendants of the old Spanish *creole* stock, the cattle make neither prime beef animals nor good dairy cows; many have been bred for draft purposes only. Nowhere is a large beef cattle industry developed; only a few steers are sold now and then to the local butchers, who distribute the meat in the fresh or dried form. In general, while cattle are kept more for their meat qualities than for milk, dairying has become more important in this region than in any other section of the country. The region has half the cows milked and produces

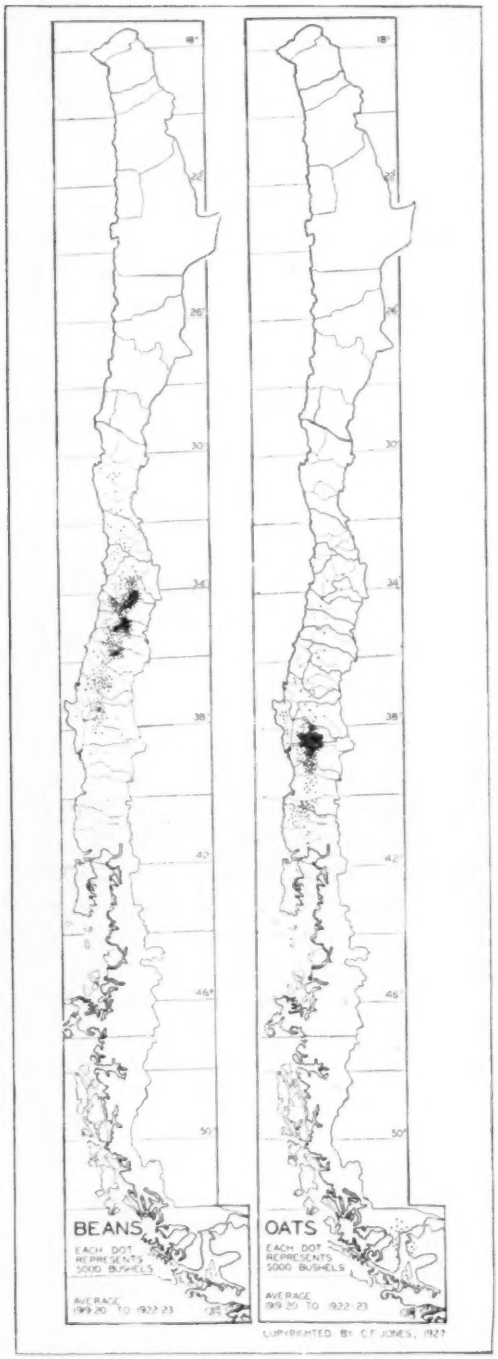

FIGURE 40.—Oats, suited to cool moist conditions, are largely confined to the Humid Pasture-Crop-Forest Region, while beans are grown only in Mediterranean Chile.

75 per cent of the butter of Chile. A large rainfall distributed throughout the year favors the growth of luscious forage; a heavy production of hay and legumes provides winter feed; cool temperatures favor the production and keeping of milk and the manufacture of butter and cheese. The large German element in the population also has been an important factor. The industry is best developed around Valdivia and Puerto Montt. Most cows milked consist of native stock with some Shorthorn blood (Fig. 41); a few establishments have Norman cattle. While the calf is small, the cow commonly is milked for a few months once daily, in the morning; calves run with the cows during the day, but they are separated at night. Nearly all the manufacturing of butter and cheese takes place on the farms with primitive methods and frequently under unsanitary conditions, resulting in an inferior product. Poor transportation facilities, lack of modern methods, and the lack of better dairy breeds prevent a more rapid development of this industry in a region where general conditions favor it.

Sheep, primarily of the merino breed, do not occupy as prominent a place in the agriculture of this region as they do in semi-arid Mediterranean Chile or in the cold bleak region bordering the shores of the Straits of Magellan. Yet they are grazed throughout the valley and on the slopes of the Andes; a few are raised on nearly every farm. They supply the wool used in a household industry by the poorer classes, which make much of their clothing, blankets, and ponchos. One-fourth of all wool clipped in this region is used in household weaving; in some sections the entire clip is so used. On the large farms sheep follow cattle as they

move from pasture to pasture; on small farms they may graze with the cattle on the same land year after year. As a result, internal parasites cause considerable loss in flocks. Water-soaked terrain, a forest cover with considerable undergrowth, cold rains in winter, and ticks constitute other handicaps. Yet the surplus wool affords a money crop of some value in a region lacking an array of marketable farm products.

Swine, raised in nearly every farming section of Chile, find especially favorable conditions in the Humid Pasture-Crop-Forest Region, where they are allowed to root for themselves in the forest or in woodland pastures. A few droves of good breeding stock have been introduced, but most of the swine consist of native breeds that have been allowed to degenerate to an inferior type of animal.

FIGURE 41.—A herd of mixed cattle in South Central Chile. The calves run with the cows.

FORESTS

Originally covering the entire area of this region, forests still occupy about half of the land; every farm has a woodlot and some land owners control vast timber holdings in the most valuable forests of Chile. The growth consists of the pine-beech-cedar Pacific forest; the Chilean pine (*Araucaria imbricata*), present in the north, disappears towards the central part of the region; several beeches—*coihué* (*Notofagus dombeyi*), *roble* (*N. macrocarpa* and *N. obliqua*), *rauli* (*N. procera*)—, laurel (*Laurelia aromatica*), *lingue* (*Persea lingue*), *canelo* (*Drimys winteri*), *alerce*, and *ciprés* or *cedro* comprise four-fifths of the stand. Mature trees attain large sizes, ranging in diameter from an average of two feet for *lengue* to three feet or more for *rauli*, *roble*, and laurel, and up to five feet for *coihué;* clear lengths of trunk range between thirty and seventy feet.

Merchantable *rauli*, *lingue*, and laurel occur only at comparatively low altitudes, *roble* extends a little higher, and *coihué* still farther up. *Alerce* grows especially in low wet lands; *ciprés* is common on slopes and even on lowlands.

A large part of the timber production is by farmers who annually increase the number of cleared acres by cutting or burning their forests for

wood or for crop and pasture land. A few companies own mills and timberland and contract with crews for its exploitation, but generally they prefer to purchase from farmers cut logs or lumber delivered at specified shipping points. This method aids farmers materially as it provides work for farm hands and animals at a time when they otherwise would be unemployed. Cut during the winter rainy season, the logs are transported to the mill, usually a small farm type, which is moved as logging progresses, since the rainy weather and wet terrain make the transportation of logs out of the forest difficult. The lumber then moves by cart, rail, or water to shipping points. As yet, the total output goes for a local and domestic supply, for lumbering is secondary to farm operations in this region.

POPULATION AND TRENDS

Despite a number of towns of some size this whole region is dominantly rural; of a total population of 700,000, approximately 550,000 are classed as rural. The aboriginal inhabitants of the region were the Araucanian Indians, one of the most virile and highly developed native races in South America; the Incas never conquered them; they successfully resisted the Spaniards; only after 1882 did the Chilean Government subdue them. They still inhabit the region in numbers as farmers or as laborers on large *haciendas* of rich Chileans; they are an agricultural people.

Prosperous agricultural communities composed chiefly of Germans and Dutch are located near Valdivia, Osorno, Puerto Montt, and on the shores of Lake Llanquihué. Many South African Dutch, after the Boer War, settled in eastern Chiloé. These people were the pioneers in the region; they burned and cut away the heavy forests, established pastures, uprooted the stumps, and broke the land for crops. They established thriving communities in hitherto deep forests, built towns, and brought in railways. At their hands the forests will continue to go down with the ax and fires in order to make room for crop and pasture land. The region itself slowly will encroach somewhat upon the forests of the Andean foothills and those adjacent to the coastal ranges.

(Another instalment of this article will appear in a later issue.)

LOCALIZATION OF THE COTTON INDUSTRY IN LANCASHIRE, ENGLAND

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ENGLAND was one of the last countries in Europe to introduce cotton manufacture. For centuries before this, linen and woolen industries had been carried on in numerous homes throughout the British Isles.

Historical Background

By the early fourteenth century, Manchester had been mentioned several times as the seat of a growing woolen industry, but in the middle of the century it experienced a great change due to the arrival in England of many Flemish and Dutch workers at the invitation of King Edward III. This is the first time that the textile industry, as such, had been officially recognized. Fuller, in his "Church History," says: "Hitherto the English were ignorant of that art, as knowing no more what to do with their wool than the sheep that wear it. But soon after followed a great alteration." For Edward III sent emissaries among the Dutch weavers. "But oh, how happy," said the emissaries of Edward, "should they be, if they would but come over to England bringing their mystery with them, which would provide them welcome in all places. Here they should feed on fat beef and mutton till nothing but their fullness should stint their stomach. . . . The king, having gotten his treasure of foreigners, thought not fit to continue them all in one place, but bestowed them through all parts of the land, that clothing might thereby be better dispersed."[1] We notice that the distribution of the industry in this early period was affected primarily by the wishes of King Edward III.

However, important social and economic conditions brought about the gradual concentration of the Dutch and Flemish textile workers in Lancashire. The first was the advantage derived from the presence of a comparatively large linen and wool industry, for even at that early date a considerable organization existed for the purchase of raw material and the marketing of the finished products. A second was the character of Manchester as a market town, governed by constables, and free from the strict regulations of the larger towns; therefore, it could offer foreign workmen the same rights enjoyed by freemen. Manchester had no stringent laws controlling apprenticeship, or the use of capital and credit, such as retarded development at this time in the south of England. A third incentive to settle in Manchester was given by the Wardens and Fellows of Manchester College. They gave workmen the right to cut from the college ground firewood and timber to construct their looms, for the total sum of four pence yearly. Last but not least, Manchester was isolated from southern England and lay outside the area ruled by the Merchant Adventurers, who were practicing a crushing sabotage at that time.

[1] Fuller, "Church History," p. 110.

By the opening of the eighteenth century, the growth and concentration of the cotton industry in Manchester was mentioned by nearly every contemporary English writer. The south Lancashire products, however, were largely mixed materials known as "fustians," a mixture of wool, linen, and cotton. Lewis Roberts remarks in his "Treasures of Traffic" in 1641 that, "The town of Manchester, in Lancashire, must be also herein remembered, and worthily for their encouragement commended who buy the yarne of the Irish in great quantity, and weaving it, returne the same again into Ireland to sell: Neither doth their industry rest here, for they buy *cotton wool* in London, that comes first from Cyprus and Smyrna, and at home worke the same, and perfect it into fustians, vermillions, dimities, and such other stuffes, and then return it to London, where the same is vented and sold, and not seldom sent into forrain parts."[2] The "cotton wool" mentioned in this quotation was probably some of the first pure cotton which came to Lancashire. Such evidence indicates the tendency toward a species of hybrid cotton goods. The Manchester weavers and merchants wished to manufacture a pure cotton cloth, but sufficient cotton yarn could not be produced by hand methods of spinning.

By the middle of the eighteenth century, a crisis was imminent. Every known method was being used to produce more cotton yarn. A weaver was often compelled to walk three or four miles in the morning in order to collect enough yarn to keep him busy during the day. Linen still had to be used for "warp," running lengthwise the cloth. At this period, in practically every house, women were continually busy on one or more spinning wheels; and men were weaving in every available space in barn, shed, basement, and garret. The industry, as such, was strikingly concentrated in Manchester and the surrounding villages. As has been shown, the social and economic conditions of the time were the important factors in its concentration, rather than any elements of the natural environment. So long as the industry was carried on by hand, the necessary humidity could be found practically anywhere in the British Isles.

[2] Lewis Roberts, "Treasures of Traffic," Orig. Edition, p. 32 and 33, published in 1641.

LOCALIZATION OF THE INDUSTRY

The next period was characterized by inventions which stimulated the rapid development of the industry. In this period, the elements of the natural geographic environment played the dominating rôle in the evolution of the industry. During the "industrial revolution" the localization of the cotton industry became definite. In 1769, and for the next 100 years, the rapidly growing industry demanded many new and varied resources, in contrast with the preceding period when raw material and the human hand were sufficient. The marked degree to which Lancashire met the new demands of the industry determined its localization there.

The pressing need in the cotton industry at this time was a method for spinning more yarn. All minds were focussed on this problem and during the middle of the eighteenth century several crude machines were produced. The first mechanical invention to succeed was Arkwright's so-called "water frame," in 1769.

This machine caused a "revolution" in the industry; later improvements only contributed to the gradual evolution. Arkwright's machine would spin several threads at once and could be run by water power. It made possible the spinning of sufficient yarn, so that cotton could be used for both "warp" and "weft," thus enabling the production of pure cotton cloth. Arkwright's invention greatly increased the number of people engaged in spinning, but the manufacture of pure cotton cloth had greatly increased the demand for yarn; hence it did not displace the skilled cotton spinners. This contributed to its rapid adoption without serious interference from the hand workers.

Before 1769, weaving and spinning were carried on in the homes, and the cotton industry was therefore concentrated at Manchester and in the surrounding villages. It was at first supplementary to agriculture, but later, because the value of the product increased, and because southeast Lancashire was in general unsuitable for agriculture, the cotton industry became the dominant source of income for practically every family. The use of water power worked a marked change in the distribution in the industry, for it rapidly spread up the numerous streams which flowed out of the nearby upland region.

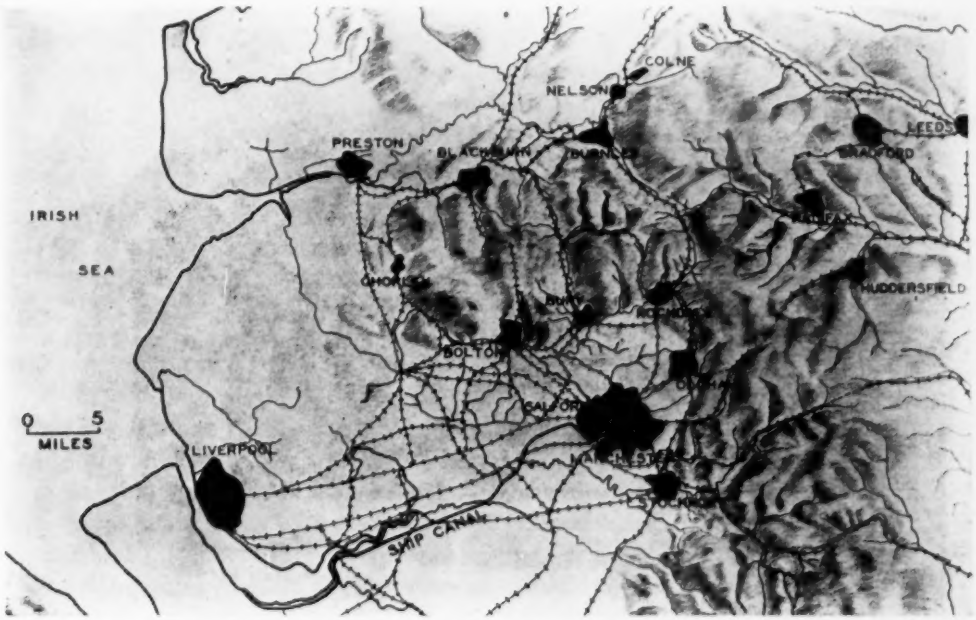

FIGURE 1.—The Lancashire industrial area. Manchester with its ring of cotton spinning towns. Contains over 3,000,000 workers. To the east are the Pennine Uplands and to the north is the Rossendale anticline. The railroads shown are the chief lines directly influencing the cotton industry. It is impossible to indicate the dense canal system or the many highways radiating from Manchester available for heavy trucking.

Manchester is located near the base of the Pennine upland, in a large indentation formed by the peninsula-like extension of the Rossendale upland into the lowland of east Lancashire (Fig. 1). It lies at the confluence of several large streams from uplands which enclose the city on three sides. These streams with their many tributaries provided nu-

merous sites for water wheels. Before long, hundreds of mills were started on these streams, but Manchester, owing to its focal location, remained the home of many of the workmen. It also became the market town for the upstream settlements, and the collecting and distributing center for the raw cotton and the finished cloth.

Rapid growth of the cotton industry continued into the nineteenth century with new mills springing up wherever power sites were available. After the changes due to this utilization of water power, the industry more securely localized than before in south Lancashire. A map of the location of the so-called "cotton factories" in 1835 (Fig. 2), when compared with the physical features and drainage, shows to what a large extent this natural resource affected the localization of the industry along the water courses.

FIGURE 2.—Cotton mills in 1835. Each dot represents one mill. The large majority of these mills used water power and carried on both spinning and weaving. Compare with Figures 3, 4, and 5, and note the number of mills which were abandoned after steam power was introduced.

Following this increase of cotton mills, a need for better transportation facilities arose, and numerous roads and canals were built connecting the new settlements with Manchester. The physical features again aided this new development which the industry demanded. The region around Manchester became a veritable network of roads and canals and later of railroads.

The manufacture of pure cotton cloth in growing quantities just prior to 1800 gave rise to a new and important process of chemical bleaching. The bleaching method previously used necessitated a period of six to eight months. The new process, discovered by Berthollet, and developed in Lancashire by Henry, Ridgway, and others, reduced the time to a few days. The chemical resources needed in this new process were chlorine, lime, and sulphuric acid. Large supplies of the first two were available in the salt field of Cheshire and in the limestone areas of adjacent Derbyshire. Liverpool's trade with southern Europe supplied pyrites from Spain at a comparatively low figure. Consequently a chemical industry grew up at the head of the Mersey estuary with salt and limestone coming by canal, and pyrites arriving by ocean boats. The industry has grown until it now supplies many parts of the world with a variety of chemical products, but the demand for bleaching powder and acid in the cotton industry gave it its first impetus. The possibility of getting these accessory materials so close at hand was another factor in concentrating the cotton industry in south Lancashire.

The progress in the industry during

FIGURE 3.—Spinning mills in 1927. Each dot represents one mill. The modern spinning mills are concentrated in the ring of towns surrounding Manchester with easy access to coal and lime-free water. Bolton specializes in fine yarns, Oldham in medium, and Rochdale in coarse varieties.

the last half of the eighteenth century was amazing, but before 1800 it felt a check. The water power sites were practically all utilized. The map of 1835 (Fig. 2) shows that many men were forced to go long distances from Manchester to find a suitable location for new mills. A quotation from Baine in 1833 shows to what extent water power had been developed at that time. "On the river Irwell, from the first mill, near Bacup to Prestolee near Bolton, there is 900 feet of fall available for mills, 800 of which is occupied. On this river and its tributaries, it is computed that there are no less than 300 mills."[3] Thus the new development in the industry created again an important demand for a new resource.

At this period, however, a new source of power was happily discovered. The first steam engine used for cotton manufacture was set up in Manchester in 1789. Arkwright adapted steam power to his machines a few years later. In many industries, such as that of iron and steel, the demand for cheap coal resulted in the migration of the industry to the source of the new "power" material. In Lancashire, the cotton industry found large supplies of coal right at hand. The extensive coal fields of Lancashire are located on the north and south flanks of the Rossendale upland. Here again the natural geographic environment of south Lancashire amply met the new require-

FIGURE 4.—Weaving mills in 1927. Each dot represents one mill. The weaving industry is distinctly localized on the northern slopes of the Rossendale upland. The mills are concentrated in the towns on or near the Burnley coal field. Compare with Figure 3.

ments of the growing industry. The result was a still stronger localization of the industry within this region. Mills, which in 1835 had been forced

[3] Baines, "History of Cotton Manufacture in Great Britain," p. 86.

FIGURE 5.—Bleaching, dyeing, printing, and finishing mills in 1927. Each dot represents one mill. Bleaching, dyeing, and printing mills are located along the streams in the upland area and in the regions southwest of Bury. The mills in and near Manchester are mostly finishing works.

to go long distances in search of water power, came back to make use of the cheap supplies of coal.

The improved means of transportation following the development of railroads made possible the growth of the industry on the north side of the Rossendale upland. Here the expansion came after the invention and use of steam power and the mills were concentrated in the towns, on and near the Burnley coal field. This is in marked contrast to the location of the mills in the south, where the primary factor had been the availability of water power (compare Figures 3 and 4).

The extremely rapid development with increasing use of steam power brought out the controlling importance of a new resource. This was the presence of pure lime-free water in quantities large enough to satisfy the increased number of mills. Pure water had always been an indispensable need in the industry, but it was not until the industry had assumed large proportions that it became a definite factor in the location of the mills. The development of steam power added to the amount of lime-free water required, because it was needed in the boilers. The rapidly growing bleaching and dyeing industry also made large demands on the available water supply. Pure water had a dominating influence on the development of the industry, and at present it practically limits the area within which mills are built. The expense of purifying the required amount of water, or bringing pure water long distances by pipe lines, would prohibit the building of mills outside this area (Fig. 7).

The supply of suitable water in each of the cotton manufacturing regions of the world is of prime significance. In New England the numerous lakes serve as natural reservoirs for the streams which furnish the water for the cotton mills. In Lancashire the main source of supply comes from the extensive thick areas of moorland and peat bogs on the summits of the Pennine and Rossendale uplands. These moorlands serve as natural reservoirs for the streams which supply this cotton industry. The rainfall varies from 40 to 50 inches annually, and most of it is retained for a time in this thick vegetable deposit. These moorlands are very common throughout the western portion of England, and develop usually above 800 to 1,000 feet. The character of the rock under these deposits, and through which the water flows, determines the character of the water. Figure 6 shows the significant bed rock geol-

ogy of the areas above 800 feet in the Lancashire district. The area within which the cotton industry is localized, bounded by the broken lines on Figure 6, is the only considerable area in the western part of England where the "Millstone Grit," or coarse sandstone, outcrops at the level where this type of moorland develops.

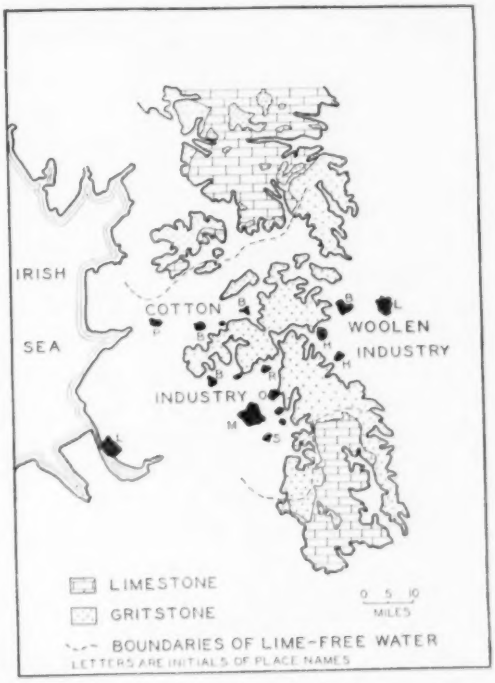

FIGURE 6.—Bed rock geology of areas above 800 feet. This figure shows the only considerable area in western England where supplies of lime-free water are available, and the significant localization of the two great textile industries.

This region, therefore, is the only important area where large supplies of lime-free water are available. It may be noted that on the eastern slopes of the Pennine upland, opposite the cotton industry, the great woolen industry is localized with similar supplies of lime-free water available (Fig. 6).

It is impossible to assume that the damp atmosphere, which is characteristic of the west coast from Scotland to Land's End, is the dominant factor in the localization of the cotton industry in Lancashire. It is a well-recognized fact that a change in the relative humidity of only a few degrees from day to day makes it impossible to manufacture an even, high-grade piece of cloth, or to spin a thread of uniform strength and consistency. Such a variation in humidity is bound to occur in even the dampest of climates and is a recognized element of the climate of Lancashire. The cotton mills of Lancashire have had, from a very early date, artificial means for maintaining the necessary temperature and humidity. These facts are brought out very clearly in the factory legislation starting as far back as 1795. Numerous bills were passed and reforms instigated for the improvement of health conditions in the factories. It was in the year 1795 that the Manchester Board of Health was established with the object of preventing the generation and propagation of disease. They made a full report in 1796 in which it was pointed out that the cotton factory was a "hot-bed of epidemics."[4] There was no immediate improvement, for in 1832 Dr. Kay still spoke of the serious dangers resulting from unsanitary conditions and bad ventilation.[5] Many acts were passed limiting hours of employment and age requirements, but it was not until 1889 that a definite law was passed imposing maximum limits of humidity for given temperatures and the maximum proportion of carbon dioxide to be allowed in the humidified weaving sheds.[6]

[4] The report is printed in full in "Hutchins and Harrison's History," pp. 9–11.

[5] Kay, James Philips, "The Moral and Physical Condition of the Working Classes Employed in the Cotton Manufacture in Manchester, 1832."

[6] Cotton Cloth Factories Act, 1889.

A brief review of the development of the cotton industry reveals its amazing growth during the period of inventions. In the first half of the eighteenth century, the increase in the amounts of raw cotton imported was trifling. During the next 20 years, it increased at a moderate rate. In the next 10 years, however, from 1771 to 1781, owing to the invention of machinery and the use of water power, the rate of increase was greatly accelerated, amounting to nearly 320 per cent. Compare the actual weights of raw material imported: before 1770 the amount was only slightly over 1,000,000 pounds annually, by 1800 it was between 30 and 35 million pounds, and by 1833 it was over 300 million. Increase continued through the nineteenth century and by 1900 it had amounted to nearly 1,800 million pounds.

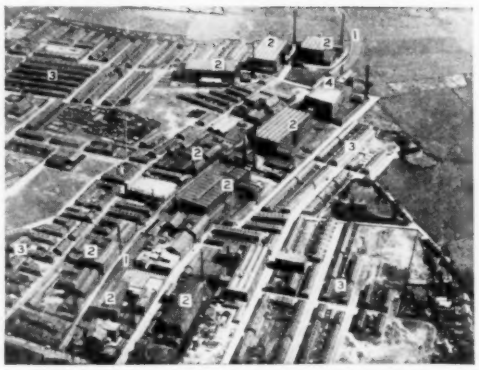

FIGURE 7.—Modern spinning mills a few miles north of Stockport. At present the smaller canals are more valuable as a source of water than as a means of transportation. The figures signify the following:
1. Canal.
2. Spinning mills.
3. Homes of workmen.
4. Reservoir on roof of mill.

INCREASING LOCALIZATION AND BEGINNING OF SPECIALIZATION

It was during the nineteenth century that the most rapid growth of the cotton industry took place. It was also during this period in the evolution of the industry that the geographic elements of natural environment practically determined its localization within its present boundaries.

In 1788 there were 72 water mills in the south Lancashire region out of a total of 143 in the United Kingdom. In 1838, approximately 82 per cent of all the cotton workers of the United Kingdom were in the Lancashire region. By 1898, however, over 90 per cent were within this region. At this same year, however, the county of Lancashire had over 95 per cent of all the cotton workers in England and Wales.

The rapid growth and centralization of the cotton industry led to specialization within the industry, as well as in the associated industries. It augmented the economies resulting from localization and improved means of transportation. There are three readily distinguishable branches within the industry. The first is the spinning section with processes such as cleaning, carding, and roving leading up to it. The second is the weaving division with the associated processes of winding and warping. The third is the bleaching, dyeing, finishing, and printing section which is more widely distributed than the other two (Figs. 3, 4, and 5). There is also further specialization within the spinning and weaving regions. Bolton and Manchester are the centers for fine yarn, while Oldham and Rochdale specialize in medium and coarse yarns, respectively (Fig. 3). Specialization has gone so far that one mill will manufacture one grade of yarn only. Most of the fine Egyptian and Peruvian long staple cotton goes to Bolton and Manchester and the medium staple cotton from the United States to Oldham, Rochdale, and the surrounding towns. In the

weaving region (Fig. 4), Preston and Chorley weave all kinds of fancy goods, Colne and Nelson specialize in colored fabrics, while Blackburn and neighborhood make shirtings and dhooties which are shipped in enormous quantities to India. Burnley made almost exclusively coarse cloth for the Far Eastern market, until recently, but it has now begun to make a large variety of goods.

This specialization would have been impossible if the cotton industry had not been so localized within a small area. With the modern means of rapid transportation, it is only a few hours from Manchester to the most remote mill. Raw cotton, landed at Manchester, direct from India, the United States, Peru, or Egypt, arrives at the mill a few hours later by motor truck. In the same way cotton cloth brought into the huge Manchester warehouses by the returning trucks is shipped by ocean liners direct from the Manchester docks to its destination anywhere in the world.

SUMMARY AND CONCLUSION

In this study of the Lancashire cotton industry, to determine definitely what part the geographic factors of environment had in the evolution of this great industry, at what period in its development they exerted the strongest influence, and, briefly, the part played by the strictly economic and social conditions, three major periods have been distinguished: first, the early concentration in the homes, when social and economic factors were most important; second, the great period of rapid growth, when the factors of geographic environment, topography, water power, coal, lime, salt, and pure water played the dominating rôle in the localization; and third, the present period, marked by increasing localization, with the geographic factors still operative. Specialization in this latter period became more definite and pronounced due primarily to economic conditions and world competition.

NEW YORK BARGE CANAL—EXPECTATIONS AND REALIZATIONS

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THE current discussion regarding the New York Barge Canal renews the perennial agitation for more waterways. It is interesting to compare the enthusiastic prophecies for the future with similarly enthusiastic promises and prophecies put forth in 1895 up to the present for this canal. Ever since De Witt Clinton's time New York State has had its canal problem. In 1825, before the time of railroads, the Erie Canal was completed. Though but four feet deep and accommodating boats of only seventy-five tons capacity, it proved to be the outstanding waterway success of the century. The cost of moving a ton of freight from Buffalo to New York was reduced from $100 to $10. The traffic estimates were realized the first year; by 1837 the traffic was doubled, and by 1854 the tonnage had increased to ten times the original figure (see Fig. 2). At this time the railroads were of minor importance, since the first railroad was built from Schenectady to Albany in 1831 and was completed to Buffalo in 1854.

Erie Canal

The preëminence of New York City as a port was due in large degree to the Erie Canal. By 1862 enlargement was deemed necessary, but in 1882 the declining use of the canal (see Fig. 2) led to a successful agitation for the removal of tolls which had hitherto been levied. Up to that date the total cost of construction, repair, maintenance, and operation was $79,000,000, only a million less than the cost of the Suez Canal. The tolls collected totaled over $121,000,000, of which some $42,000,000 was net profit.[1] This, together with the savings from reduced freight rates, caused the Erie Canal era, 1825–1883, to be an outstanding period in New York's economic history.

The abolition of tolls did not increase canal traffic so much as was expected. The rail traffic, however, increased rapidly and the canal lost its supporters. In his report, Comptroller Ira Davenport admits disappointment in the lack of increased canal activity and interest in boat building.[2] In 1884 State Engineer Seymour declared that free canals were a failure, and that state waterways had outlived their usefulness. He said, "It must be regarded as a foregone and inevitable conclusion that the canals must go."[2]

For ten years (1885–1895) the Canal Improvement Union fanned the dying embers of canal enthusiasm. During this period many of the locks were lengthened, but the actual capacity of the canal was not changed. Then came the $9,000,000 fiasco. The people of the state were led to believe that the canal could be enlarged from the seven-foot to a

[1] Governor Alfred Smith, Annual Message to Legislature, *New York Times*, Jan. 8, 1925, 20: 5.
[2] Frank Williams, N. Y. State Engineer, *History of the Barge Canal*, p. 21, 1921.

nine-foot depth for this sum. Even a very hasty and incomplete estimate on the part of the engineers was 12½ million dollars, and later in 1896 the estimate was 16 million dollars. But the Legislature evidently thought 9 million was all the people would be willing to authorize. Finally, when two-thirds of the canal improvement was finished, work suddenly stopped for lack of funds. The people were

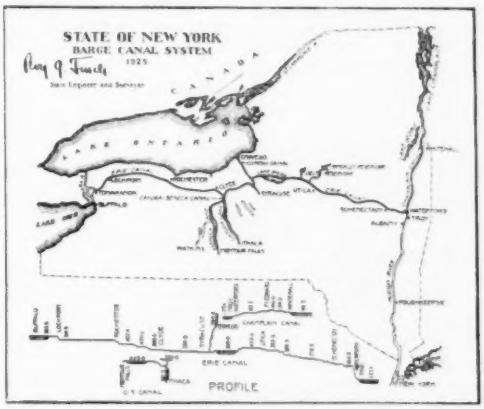

FIGURE 1.—The route and profile of Barge Canal System.

naturally disappointed, distrustful of state officials, and suspicious of the whole affair. It was charged that fraud and graft were associated with the expenditure of the money. An investigating committee, however, recommended a continuation of the improvement regardless of cost. During his governorship Theodore Roosevelt made the following statement:

"The Commerce Commission's report makes it perfectly clear that there never was sufficient authority, or indeed any authority, for supposing that this $9,000,000 would be enough to complete the work and that a sum was named which was entirely insufficient. It was doubtless believed to be easier to get the small sum than a large one."[3]

The result was that the traffic on the canal continued to decline. In 1870 the rail and water traffic of the state were about equal; but by 1900 the canal traffic was only 5 per cent of the rail traffic.[4] Yet, according to a state constitutional amendment, "The legislature shall not sell, lease, or otherwise dispose of the Erie Canal, the Oswego Canal, the Champlaine Canal, the Cayuga and Seneca Canal or the Black River Canal; but they shall remain the property of the State and under its management forever." In other words, they must be kept up whether or not there was adequate business.

BARGE CANAL—ESTIMATED AND ACTUAL COSTS

It is interesting to note how the cities of Buffalo and New York with their various trade, commerce, and traffic associations and unions kept alive the canal agitation, and to note how through their many conventions, enthusiastic speakers, and wide circulation of canal literature, they finally aroused a certain amount of support for a thousand-ton-barge canal. The New York Produce Exchange was the life and soul of this movement. Governor Roosevelt was also an enthusiastic exponent of waterways. Now that we have had upwards of eight years in which to test the truth of these promises, it may be well to quote some of the prophecies put forth since 1897 by various state officials, engineers, legislators, and journalists, predicting the certain results of a larger and better-equipped canal:

"When the limit of the capacity of the new canals shall have been reached and from 20,000,000–30,000,000 tons of freight are carried over them the great reduction in rates that will have attracted such a volume of freight to our canals, will, we believe, be the least of the accomplishments. It is our firm conviction that the reduction in freight rates that will be forced upon the railroads paralleling the canals and which carry fully 50 times as much today, as the canals carry in the matter of freight, will be so large as to greatly stimulate and permanently maintain an increase in their freight traffic, will tax to the very uttermost the maximum capacity of these roads, and force the laying of additional tracks, as

[3] Frank Williams, N. Y. State Engineer, *History of the Barge Canal*, p. 51. 1921.

[4] Frailie, *Quarterly Jour. of Econ.*, Vol. 14, pp. 212–239.

well as the construction of additional railroads to accommodate the traffic that will offer."[5]

"The operation of this great waterway to its maximum capacity would directly benefit the general public to the extent of $3,000,000 per year besides the important indirect advantages resulting from a great freight movement through the state."[6] The fact is that the Barge Canal has cost nearly three times as much as the original Suez Canal cost and does not carry one-tenth as much traffic.

Governor Roosevelt made the following statements in his message transmitting a report of the Canal Committee:

"If canals are made large enough they can successfully compete in the transportation of high-class freight which is now exclusively carried by railroads at high prices.

"But $62,000,000 is not too large a sum for the great state of New York to expend if it will secure for at least a generation the same canal advantages which were secured to this state in the early decades of the century by the original diminutive canal."[7]

This predicted $62,000,000 has already grown to over $230,000,000.

Many of the promises made by the canal advocates about 1900 had their intended psychological effect on the people of the state. Governor Roosevelt appointed a committee to investigate and to report on the enlargement of the Erie and associated canals. After a study of American and European waterways, the committee reported in favor of the enlarged canal. The estimated total cost on this occasion was $62,000,000. In the committee report the following statement was made:

"We fully realize the responsibility attached to the making of these estimates, and we feel that we have taken every precaution within our power to avoid the error of estimating below actual cost. . . . We feel reasonably confident that the figures we now present are sufficiently accurate as a basis for legislation and a vote of the people, and we think the result of further surveys will be to decrease to some extent the estimates we now present."[8]

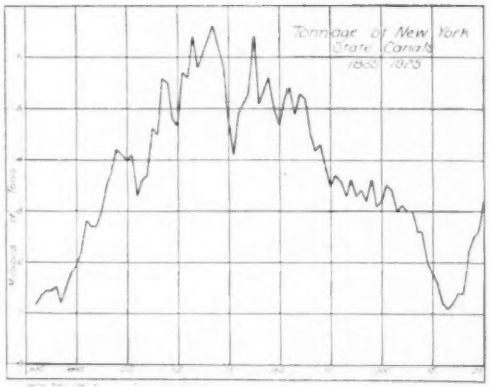

FIGURE 2.—Graphical representation of total tonnage carried on New York State Canals from 1835–1925. (From Survey Report, Supt. of Public Works, 1922, 1925–1926.)

It should be noted here that the preceding State Canal Committee had estimated the cost of completing the canal as $58,900,000. Thus in place of the earlier $9,000,000 improvement, which had failed, a $58,900,000 estimate was given in 1899, and an increased estimate in 1900 of $62,000,000. By 1901 the state engineers reported a probable cost of $87,000,000. Here again in 1901, the engineers after raising their estimate by $25,000,000 made a statement very similar to the one accompanying the previous estimate:

"Resolved, That in the opinion of the Board, the work (survey and plans) has been done thoroughly and in a manner which meets its approval and that the estimates and reports in which the results of these surveys and work have been embodied are entitled to the confidence of the people of the state of New York."[9]

Finally, in 1903, when the Barge Canal bill was passed by the Legislature, the estimate, which had been thought fully adequate at about half the new figure, had increased to $101,000,000. When submitted to the people for a vote those favoring the plan were about 250,000 in the

[5] Report of Barge Canal Terminal Commission, 1911, Vol. 1, p. 36.

[6] W. W. Witherspoon, State Superintendent of Public Works. From address at State Waterways Convention, Utica, N. Y., Oct. 4, 1917, "What the N. Y. State Canals Can Do," p. 10.

[7] N. Y. State Assembly Doc. No. 123, Sess., 1900, Vol. 19.

[8] Report of Committee on Canals, 1900, Assembly Doc. No. 79, p. 24.

[9] Williams, *op. cit.*, p. 88.

majority, out of a total vote of 1,100,000. Only 16 of the 61 counties, however, voted in favor of the improvement. As would be expected, New York and Buffalo voted heavily for the measure.

But the cost of the Barge Canal repeated the experience of canal predecessors (see following table).

Canal	*Estimated Cost*	*Actual Cost* [10]
Suez	$30,000,000	$80,000,000
Manchester Ship Canal	£8,262,936	£16,790,491
Panama Canal (original estimate)	$140,000,000	$375,000,000
Chicago Drainage Canal	$16,000,000	$53,000,000

FIGURE 3.—Old type of wood barges still often used on the canal but destined to give way to more modern equipment. (Courtesy of Supt. of Public Works, Albany, N. Y.)

In his message to the Legislature in 1925 Governor Smith said:

"The Barge Canal, including construction, terminals, grain elevators, repairs, maintenance, operation, and payment of claims for damages has cost the people *since 1905* up to date, $191,626,000; between 1905 when first canal bonds were sold up to 1924 inclusive we have paid in interest $39,880,387, making total cost of Barge Canal to date $230,881,000. . . . To complete the canal to a point that would make unnecessary the enormous annual expenditures for dredging, complete the terminals, relieve sharp bends that interfere with navigation and do other essential things, will cost approximately $16,606,000. I am further informed at the office of the attorney general, that there are pending against the state 751 claims for damage to water rights and privileges, appropriation of land and so on, the face amount of which is $23,892,473."

Compare this with the Barge Canal original estimate of $59,000,000 and the later appropriation of $101,000,000.

[10] *Jour. Pol. Econ.*, 23: 490–500 (1915).

PREDICTED AND ACTUAL TRAFFIC

One may well ask: "What has been the outcome of this large expenditure of public money?" It had been predicted that the tonnage would quickly rise to 20,000,000 tons per year. The original Erie Canal fulfilled in the first year the hopes of its exponents. But in this age of competing railways instead of a 20,000,000-ton business, the canal has carried in the eight years since it was officially opened (1918) an annual average of but 1.9 million tons. In 1925, 3.2 million tons were carried on all the New York State Canals, or 16 per cent of what was predicted. Even as late as 1920 Mr. Walsh, Superintendent of Public Works and a man who has spent his life in transportation business, chiefly on the state waterways, made the following statement in his report:

"I predict a constantly increasing annual traffic. In my judgment the next five years will witness the restoration of a water-borne commerce through the state between the Niagara Frontier and tidewater that will eclipse even the wonderful achievements of the original Erie Canal." [11]

Yet the statistics of five years later show that (see Fig. 2) the traffic

[11] Williams, *op. cit.*, p. 387.

FIGURE 4.—Newer type of steel barges rapidly displacing the antiquated type used so many years. (Courtesy of Supt. of Public Works, Albany, N. Y.)

carried on all the canals in New York in 1925 was not even equal to that carried on the old Erie Canal in the last year previous to the Barge Canal improvements. Moreover, the present tonnage is only one-half that of the leading years of the old Erie Canal.

NON-EFFECT OF WATERWAY ON RAILROAD RATES

One of the strong arguments put forth by the canal advocates was the assurance that the canal would act as a regulator of railway rates. In 1901 a canal convention in Buffalo adopted the following resolution:

"Resolved, That it is the sense of this convention that in view of this unjust discrimination against the people of the State on the part of railroads, we must preserve, enlarge and improve our State lakes, rivers, and canals as the only safeguards for our people against such excessive railroad rates and discrimination, and as regulators of all through and local railroad rates in our State." [12]

In 1902 Governor Seymour wrote:

"If they do not carry a pound of freight it would be wise to keep them in order, so that they would be ready for use to defeat unjust and hurtful charges against the business of New York." [13]

[12] Buffalo Hist. Assoc. Pub., 1909. From official minutes of the Committee on Canals, Buffalo Convention, 1901, p. 27.

[13] *Ibid.*, p. 59.

Replying to such contentions, Mr. F. S. Greene, Superintendent of Public Works, gave the following statement in his report to Governor Smith in 1926:

"It has been testified that the canal saves the people of the state $50,000,000 annually in 'depressed' rail rates. This has not been proven to my satisfaction. The Old Erie Canal undoubtedly served to 'depress' rail rates; this, however, was before the existence of the two rate-regulating authorities: the Interstate Commerce Commission and Public Service Commissions." [14]

Then he asks the following questions, the answers to which are self-evident:

"1. Would these authorities have allowed rail rates to be increased $50,000,000 a year if the canal were not built?

"2. Are states, lacking canals, overcharged by the railroads $50,000,000 or in proportion according to the amount of freight carried?

"3. Is not a club costing $10,500,000 a year an expensive weapon to hold over the heads of the railroads?" [14]

It hardly seems conceivable now that the experts on rates at that time could find the only means of lowering rail rates by building an expensive canal. The legislative acts creating rate-governing bodies have been able to perform this duty so much more effectively. This is borne out in the statement of the newly elected State

[14] Greene, F. S., Special Report to His Excellency, Governor Alfred E. Smith, 1926, p. 4.

FIGURE 5.—Only in rare cases is the bridge problem particularly significant in the Barge Canal route. Such solution as this excellent bridge illustrates is not uncommon. (Courtesy of Supt. of Public Works, Albany, N. Y.)

Engineer and Surveyor, Roy G. Finch. "As a regulator of freight rates, the function of the canal has ceased because of regulation by Public Service and Interstate Commerce Commissions." One may well ask the question: "How many of those 675,000 people who voted for the Barge Canal in 1903 would have done so if they had known that the canal would cost them almost two and one-half times as much as they first appropriated, that the tonnage would be but about one-tenth of what was predicted, that every ton of freight carried on the canal would cost each taxpayer considerably more than the railway charged for the service in addition to the rate paid by the shipper?

PREDICTED AND ACTUAL EFFECT ON IRON INDUSTRY

One of the specific forecasts made concerning the growth of the iron and steel industry of Buffalo and New York State as a whole was the following:

"It is not alone, however, the export grain trade which requires the enlargement of the Erie Canal. . . . But the changes which are now taking place in the iron trade give reason to believe that if an adequate waterway can be secured between Lake Erie and the Hudson River the center of the iron industry can be brought within the state of New York. . . . We believe that a suitable enlargement of the Erie Canal at the present time is justified by the prospect of its use in connection with the manufacture of steel and iron and shipbuilding, fully as much as its original construction was justified by the prospect of transporting breadstuffs." [15]

Governor Roosevelt in an address said that a really adequate waterway would make Buffalo a possible commercial rival of Chicago, and would put her far beyond the chances of rivalry with any other city on the Great Lakes, and that it would make her in all human probability the center of the iron industry of the country.[16] In one of his messages Governor Roosevelt made an even broader statement:

"The growth of Buffalo as an iron center would be enormously stimulated and in turn would of itself fully compensate for the proposed enlargement of the canals." [17]

"We propose making Buffalo the greatest manufacturing center on the Lakes. At the same time we will be able to furnish all kinds of iron and steel material to all local points through the state and to New York City at prices that cannot be equalled anywhere in the country. This will culminate in manufacturing all along the canal and will in a few years make the canal and the river as well the greatest manufacturing section in the world. Buffalo has practically forgotten the grain traffic in view of the bright future opening up in other lines." [18]

[15] Report of Major T. W. Symons in Report of Chief of Engineers, U. S. Army, 1897, p. 3174.

[16] Gustav Schwab, *New York City's Part in the Reconstruction of States' Waterways*, Buffalo His. Soc. Pub., 1909, p. 44.

[17] Report of Committee on Canals, N. Y. State Assembly Doc. No. 123, Sess., 1900, Vol. 19, No. 79.

[18] Speech by Senator Davis, quoted in Williams, *op. cit.*, p. 99.

FIGURE 6.—The locks of the old Erie Canal and those of the new Barge Canal at Lockport. (Courtesy of Supt. of Public Works, Albany N. Y.)

"It will benefit the steel manufacturing of New York State and will make New York as great as Pennsylvania and Ohio."[19]

Some figures of New York's pig iron production since the canal has been fully completed are rather astonishing when compared with the above predictions. In 1910 New York produced 7 per cent [20] of the total pig iron of the United States. By 1924 the percentage had actually decreased to 6 per cent.[21] In comparing the New York production with that of Ohio and Pennsylvania we find the following:[21] New York, 2 million tons; Ohio, 7½ million tons; and Pennsylvania, 11 million tons. Evidently the canal has not had the promised effect on the iron industry of New York.

Thus, it is not difficult to see from the foregoing facts that the promises vastly exceeded the actual results. In his "History of the Barge Canal," State Engineer Frank Williams, who has always been friendly to the canal, admits that it has not attained a large amount of success. This is very mild when compared with Colonel Greene's uncomplimentary name for the canal, which he calls "A white elephant."[22]

ATTEMPTED REMEDIES

When the promises were unfulfilled the advocates, of course, had to search for an explanation. Thus, they put forth a series of excuses why these events as prophesied had not been executed. They were deficiencies in canal construction or equipment of one kind or another which hindered the rapid development of traffic. One by one as these impediments have been overcome, always with more expenditure of public money, the citizens have hoped for the promised 20,000,000-ton traffic to result. But disappointment follows and more excuses are given, more money invested, and yet the traffic does not pay. It seems to be an endless and a profitless circle. In order to get back part of the $230,000,000 which it has squandered, the state is now making every effort to sell the canal to the Federal Government for a ship canal. In other words, the state is hoping that Congress will buy their "white elephant."

To bear out the above conclusions it may be well to analyze the "reasons" given for the diminutive amount of traffic. Engineer Williams, a canal exponent, writes: "In discussing the commerce on the Barge Canal the negative features, if the term may be used, loom larger than the positive. Moreover, the recital appears less like a history than an explanation, so many untoward situ-

[19] *World's Work*, Vol. 34, pp. 361–362 (1917).
[20] *Mineral Industries*, Vol. 25, p. 402.
[21] *Ibid.*, Vol. 33, p. 382.
[22] *Rochester Times Union*, Jan. 8, 1926.

ations have arisen to hinder the building up of canal traffic."[23]

One of the first unforeseen needs was terminals. "Undoubtedly the most essential requirement is the establishment of adequate terminals properly controlled. Under present conditions the advantage of cheaper transportation which the waterways afford is largely nullified by the lack of such terminals."[24]

In 1911, $19,800,000 was appropriated for terminals, but later, additional money was asked to make the original expenditure effective. As a result sixty-six terminals were constructed.[25] Thus, this difficulty was overcome. It had been repeatedly announced that these terminals would ensure the extensive use of the canal, but note carefully the result on traffic. "During the past two years (1924–25) no freight was handled at 49 of these terminals and only 5 warehouses were used for canal freight. . . . The terminal at so important a city as Albany costing $312,914 had received but one small canal shipment (lumber) during the past two seasons and in that time no canal freight at all has gone in or out of the freight house.[25]

But grain elevators had not been provided for in the terminal facilities. There were no elevators at Oswego; the ones in New York either were unsuited for canal boats or were owned by the railroads. Consequently $1,000,000 was asked for and appropriated for an elevator at Oswego, and almost $2,000,000 for one at New York. The advocates of the Barge Canal affirmed that no other route, rail or water, could compete with the New York waterway in traffic if proper equipment were supplied.[26] In Buffalo there are 23 elevators with a storage capacity of 28,250,000 bushels.[27] But in spite of the splendid equipment and increasing importance of Buffalo as a grain port, the traffic was not increasing as had been expected. The "obvious

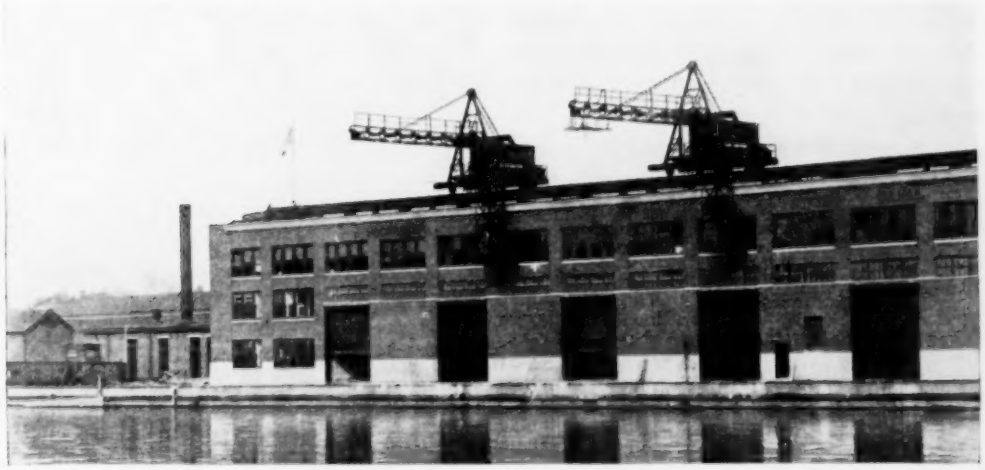

FIGURE 7.—Modern terminal at Rochester, New York, illustrative of future developments as inland water transportation assumes the part it must inevitably play in the near future. (Courtesy of Supt. of Public Works, Albany, N. Y.)

[23] Williams, *op. cit.*, p. 381.

[24] Report of Barge Canal Terminal Commission, Senate Doc. No. 469, 62nd Cong., 2nd sess., pp. 20–21.

[25] Greene, *op. cit.*, p. 5.

[26] Williams, *op. cit.*, p. 205.

[27] *Ibid.*, p. 207.

remedy," according to Engineer Williams, was the acquisition at Buffalo of an elevator by the state.[27]

Now that the state has provided two expensive elevators for the canal grain traffic, it is interesting to see how much they are used. The statistics for 1925, the best year in the Barge Canal traffic, show that the grain traffic was so small that a loss of considerably over $100,000 accrued to the state for each of the two elevators.[28]

In the early days of the Barge Canal improvement, a law was enacted prohibiting a boat owner from investing more than $50,000 in boats. This naturally prevented the development of a modern transportation system. About 1911 this law was repealed, but there has continued to be a crying need for more boats, and better-equipped boats. A Federal committee made a visit about 1917 to investigate the usefulness of the canal. Their report was not made public, but evidently it was not favorable, at least so far as the immediate use of the canal was concerned. "But in spite of all that had been done, tangible results did not follow either in using the canal or in preparing to use it and the canal enthusiasts of the state became restive."[29] A convention was called and, as a result, in 1918 Engineer Williams appeared before the Federal Senate Committee on Commerce and pleaded for boats to be provided by the government. He argued: "That boats were sadly lacking, and, moreover, that it was virtually impossible for private enterprises to construct boats; and if the canal was to be utilized as a military adjunct it became the duty of the Federal authority either to build the floating equipment or to assist by some method in providing it."[30]

FIGURE 8.—Modern grain elevator at New York terminus of Barge Canal. The sound development of adequate transportation systems must finally depend upon combined rail and water routes, and modern equipment for handling freight is a necessary part of the system. (Courtesy of Supt. of Public Works, Albany, N. Y.)

In April, 1918, a formal announcement was made that government boats would be secured and an operating organization to utilize the state canals would be established. This news was hailed with joy. Many expected that this government aid would solve a problem which otherwise would have taken years. Many believed that "this use of the new waterway in time of the nation's direst need would justify the cost of its building even if it were never used afterwards."[31]

Here again the people were doomed

[27] Williams, *op. cit.*, p. 207.
[28] Greene, *op. cit.*, pp. 7, 8.
[29] *Ibid.*, p. 341.
[30] Greene, *op. cit.*, pp. 342–343.
[31] *Ibid.*, p. 343.

to disappointment. The government furnished the very best equipment, the most modern and costly on the state waterways. There was a large volume of freight to be moved. Railroads were congested, and found it difficult to handle the traffic. Yet in 1918 and 1919 the United States Government fleet on the canal operated at a large loss, and a still larger deficit occurred in 1920. "The report of the Chief of Inland and Coast-wise Waterway Service for the fiscal year, 1920, comprising only 45 days of the navigation season of 1920, shows a loss of $62,670. The deficit for the entire season of navigation will unquestionably exceed $500,000."[32]

Thus the Federal canal fleet of 95 barges costing 4½ million dollars did little or nothing to stimulate the canal traffic. In fact "it proved in the end to be almost a death blow to any hope of a successful traffic on the new waterway."[33]

The friends of the canal now said that as soon as the Federal control terminated, private carriers could start in. Surely, the long-promised success must be at hand, 66 enlarged canal terminals, modern elevators, and other modern equipment for handling freight, several years of normality in freight transportation, and recovery from Federal control, during and just after the war! Yet, evidently few shippers and boat companies had enough faith in the canal to build costly modern canal barges for general business. The rail rates are relatively so low and the service so good that public carriers offering slightly cheaper water rates and giving good service, cannot make enough profit to tempt any very large investment. The conditions are quite different now from those of the time of the old Erie Canal. The small mule-towed, wooden boats necessitated a small investment of capital. Therefore the carrying charges during the five months' closed season were also small. "It is a different financial problem when a modern self-propelled vessel costing from $100,000 to $250,000 must lie idle five months, under heavy interest charges, insurance and a subsidy to both engineer and captain."[34] In fact, Colonel Greene finally concludes that the reason why the canal has not succeeded is because of the limited season open to traffic movement. In other words, ice for five months has prevented its success. Surely this can hardly be included among the "untoward circumstances."

The latest move is to make out of the Barge Canal, or a part of it, a Ship Canal and induce the United States Government to take it over. Colonel Greene says:

> "The Canal ought to be taken over by the Federal Government and deepened for the benefit of Western grain growers who want cheap and ready access to Atlantic seaboard for their products."[34]

He frankly confesses that he knows of no way to make the Barge Canal, on which the state has spent in the last twenty years about $230,000,000, a going concern or a paying proposition.[35]

CONCLUSION

The failure of the Barge Canal is of nation-wide interest, for it shows the general condition of practically all inland waterways. The Great Lakes are an exception, for they stand in a class by themselves. The Barge Canal has not failed for special reasons peculiar to itself, but for reasons characteristic of inland wa-

[32] Greene, *op. cit.*, 357.
[33] *Ibid.*, p. 340.
[34] Greene, *op. cit.*, p. 6.
[35] Greene, *New York Times*, Jan. 8, 1: 6.

terways of the United States at the present stage of our economic development. If any waterway should succeed it is the Barge Canal, for it has many natural advantages such as its east-west direction, its route between New York City and the Great Lakes, its rich agricultural and industrial tributary areas, and its extremely low course across the Appalachian Highland. But in spite of these and other natural aids it has failed. Even in a British Commission report made some years ago, the present-day inadequacy of inland waterways is recognized. "That the habit of using railroad transport, even for purposes not really requiring the speed of delivery which railways can supply, has become inveterate among traders and would not be weakened even if superior waterways were brought into existence."[36]

Transportation conditions have changed since the middle of the nineteenth century when the Erie Canal was in its prime. Now the railroads are in a condition better than ever before. The latest reports show that more traffic is being carried on them and carried more efficiently than ever before in their history. The delays of transshipment, and of slow canal boat movement, and the limited navigation season, outweigh the benefits of a slightly lower rate. In other words, we have passed out of the canal and river period in transportation. Such waterways are obsolete in the United States.

[36] Barge Canal Terminal Commission Report, Vol. 1, 1911, p. 75.

BOOK REVIEWS

DEPARTMENT OF COMMERCE

Bureau of Foreign and Domestic Commerce

Commerce Yearbook of the United States for 1926, Volume II.

Commerce Yearbook, Volume II, dealing with foreign countries and non-contiguous territories of the United States has just been issued for the first time. Previously the *Commerce Yearbook* was in one volume which contained principally text, statistics, and maps, relating to the trade of the United States, and a limited amount of material on foreign countries. In response to the demand for an expansion of this foreign material the *Commerce Yearbook* is now published in two volumes, and will appear annually in this form. The reviews of the various countries and the statistics presented in the *Commerce Yearbook of Foreign Countries* afford a picture of world economic conditions today. The economic reviews and statistical data relating to production and trade, transportation and communication, labor conditions, price movements, currency and exchange, foreign trade, and to other matters affecting the general business situation. The statistical data are for 1926 or the latest available, and relate to area, population, education, births and deaths, climate, and the like. In the second part of the volume are proof comparative statistical tables giving data as to each of the number of major subjects for various countries. It also contains a section on international trade.

The maps were prepared by the Geographical Section of the Bureau, especially for this volume. The use of an equal area base for the world map is a notable contribution to statistical and commercial mapping. This base was prepared coöperatively by the Bureau of Foreign and Domestic Commerce and the United States Coast and Geodetic Survey. The United States is placed in the center of its trading area and all countries of the world appear in correct relative proportion and position. On the dot population map, true distribution of dots is shown, as cannot be done on the mercator map formerly in use. The trade maps picture the concentration of commerce in certain regions, and the small amount of foreign trade carried on in other localities. They also impress to the eye the comparative importance of the trade of various countries, and the relation in value between exports and imports. The places indicated on the outline map of the world correspond to those appearing in the foreign trade statistics of the United States.

It is believed that this *Commerce Yearbook for Foreign Countries* will prove of great service to American students and business men. The price is $1.25.

The Electrical Equipment Market in India. Trade Information Bulletin No. 513. Price, 10 cents.

Though dealing primarily with the possibility for selling electrical equipment, this study places a worthwhile picture of some phases of Indian life and industry.

Nicaragua Commerce Economic Survey. Trade Promotion Series No. 54. Price, 30 cents.

The author of this handbook, Harold Playter, American Consul at Corinto, provides information regarding a region for which little source material is available. Extreme difficulty was encountered in the collection of the material because of inadequate communication facilities and unsettled conditions, and it was only the writer's personal and intermediate knowledge of the country which made it possible to prepare so thorough an economic study of the Republic. Mr. Playter's long residence in Nicaragua also enabled him to select material judicially, and to confine his attention to the presentation of facts of fundamental importance. He gives considerable attention to the description of trade centers and natural resources of the region, particularly of the coffee, banana, and lumber industries, on which the prosperity of Nicaragua depends to a great extent. American capital is a dominant factor in the development of Nicaraguan industries and natural resources, and it is the further expansion of these industries and to the greater development of these natural resources that the country looks for the building-up of a stable economic life. An original map of the country based upon Mr. Playter's information accompanies the bulletin.

Market Research Agencies, 1927 edition. Domestic Commerce Series No. 6. Price, 15 cents.

To all persons interested in market investments this is a source book for research work in the field. A total of 544 agencies are reported, covering many industries and sections of the country.

Monthly Summary of Foreign Commerce of the United States. Parts 1 and 2. Subscription price, $1.25 a year. Same copies, Part 1, 10 cents; Part 2, 5 cents.

The statistics of foreign trade are almost immediately made available through this monthly publication. The June and December issues contain, respectively, summary reports for the preceding fiscal and calendar years.

The Guianas Commerce and Economical Survey. By M. J. Meehan. Trade Information Bulletin No. 516. Price, 10 cents.

Information regarding the Guianas is now readily available; consequently this bulletin which describes the geographic, economic, and commercial expansion of the colonies has considerable value and contains an original map.

Commerce Reports Index.

Commerce Reports, the weekly publication of the Bureau of Foreign and Domestic Commerce, contains many descriptions, maps, and illustrations relating to aspects of foreign trade and the countries themselves. Detailed index to this journal is issued quarterly during the calendar year.

Sales Territories in China. By Charles K. Moser. Free.

The author has written this valuable analysis of China sales territories as the outgrowth of long residence in China and intensive study of its life and industry. It is both a practically and scholarly analysis of conditions.

Trade of the Pacific Coast States with the West Coast of South America. By Spencer B. Greene and Robert M. Lane. Trade Information Bulletin No. 525. Price, 10 cents.

The Trade statistics of Ecuador, Peru, Bolivia, and Chile, generally designated as the Western Coast countries of South America, show a steady increase in amount of exports to and imports from the United States. The authors have spent considerable time in that region and embody the results of both travel and study.

Trading under the Laws of Porto Rico. By Joaquin Servera. Trade Promotion Series No. 15. Price, 10 cents.

For those interested in foreign trade this bulletin, as well as others of the same type already published, has especial interest. Information is presented concerning the most important commercial laws in force at the present time in Porto Rico, together with a brief outline of its system of law.

Marketing of Crude Rubber. By E. G. Holt, Trade Promotion Series No. 55. Price, 45 cents.

World trade in crude rubber is of considerable interest from many points of view. The book assembles for the first time statistical information regarding rubber production (exports), and consumption (imports), and stocks, where available, for every country of any importance in the production of crude rubber or the manufacturing of rubber goods. A discussion of restriction of rubber exports for the Middle East, its effects on marketing, and complete statement of the restriction laws and rules of the Federated Malay States form a separate section of the report. This report reviews marketing methods in all important crude rubber trading centers.

BUREAU OF MINES

Mineral Resources of the United States, 1924. Parts I and II. Price, $1.00 each.

A detailed discussion of mineral production in the United States together with complete statistics.

Potash Mining in Germany and France. Bulletin 274. Price, 25 cents.

Potash is an important ingredient in the manufacture of many products of modern industry, but is indispensable in agriculture. This bulletin discusses conditions in the principal German and French potash and mining districts, presents carefully selected statistical material and contains several maps.

Petroleum Refinery Statistics, 1926. By G. R. Hopkins. Price, 20 cents.

Index to Bureau of Mines Publication for July, 1927.

Analyses of Indiana Coals. By W. N. Logan. Price, 10 cents.

In addition to statistics and the map of the field and brief text presents analyses of mine samples, and description of the coal.

Mineral Resources of the United States, 1926.

Separates for phosphates and rock, coke and by-products, silver, copper, lead and zinc, stone and zinc, slate, potash, tin, salt, barite, antimony, gold and silver, asphalt and lime are now available, and a number of others. Price, 5 cents.

COAST AND GEODETIC SURVEY

United States Coast Pilot, Philippine Islands, Part I. Price, 75 cents.

This publication covers the coast of Luzon, Mindoro, and the Visayan Islands, with the adjacent islands and waters. It contains careful descriptions of harbors and land along the coast of the islands.

Magnetic Declination in California and Nevada in 1927. No. 396. Price, 15 cents.

BUREAU OF FISHERIES

Physical Oceanography of the Gulf of Maine. By Henry B. Bigelow. Price, $1.50.

In addition to text and statistical data, this bulletin contains a number of maps relating to depth, salinity, surface temperatures and temperatures at various depths. It discusses the successive heating and cooling of the water from season to season and the effect of all physical conditions upon fish life.

BUREAU OF THE CENSUS

Further separates have been issued for the Census of Manufactures for 1925. Price, 5 cents each.

Record Book of Business Statistics, Part I. Textiles.

This supplement to the *Survey of Current Business* furnishes a background of facts from earlier years for comparison with the current data. Thus figures for corresponding months of previous years can be located at a glance, and studies can be made of the growth of each industry, of the changes in seasonal operations, and of the influences of important events in the past.

Survey of Current Business presents each month a picture of the business situation by setting forth the principal facts regarding the various lines of trade and industry. Subscription price, $1.50 a year.

United States Census of Agriculture, 1925. Part II, Southern States. Price, $1.75.

This volume includes all the separate material issued on the Southern States and is extremely detailed.

Census of Agriculture, 1925. Part III, The Western States. Price, $1.00.

Examples in one volume of the data previously published in separate book.

U. S. DEPARTMENT OF AGRICULTURE

The floods of 1927 in the Mississippi Basin published in *Monthly Weather Review*, Supplement 29.

The flood situation in the lower Mississippi Valley has attracted widespread interest. In the preparation of this report several meteorologists of the U. S. Weather Bureau have assisted H. C. Frankenfield, the Senior Meteorologist, who had charge of the report. The statistics in text are made more vivid by maps and pictures.

U. S. SHIPPING BOARD

From time to time the United States Shipping Board publishes reports in tonnage of the water borne commerce of the United States. These include total statistics, statistics for intercoastal traffic and by ports of origin and destination and principal commodities; and the imports and exports commodities by United States coastal districts and foreign trade regions.

HELEN M. STRONG.

DEMANGEON, ALBERT. *Isles Brittaniques.* (Geographie Universelle, Volume 1, 1927.) Published under the direction of P. Vidal de la Blache et L. Gallois. viii and 320 pp.; maps, charts, and illustrations. Librarie Armand Colin, Paris.

Belgique—Pays Bas. (Geographie Universelle, Volume 2, 1927.) viii and 250 pp.; maps, charts, and illustrations. Librarie Armand Colin, Paris.

In these days of specialization it is gratifying and even refreshing to find regional geographical treatments as complete and brilliant as these studies about Great Britain and Belgium-Holland. Although based on personal observation, both books show the advantage of being written by an outsider, who can better grasp the important facts and give a clearer picture than one who is submerged in the details of the subject discussed. Both books are developed very much in the same way—first, a general treatment including structure, relief, climate, bodies of water (his chapter of the struggle against the water by the Dutch is very interesting) and the people; second, a regional discussion; and third, the economic aspects of the countries.

The second division—regional treatment—forms the most valuable part of his books. It is here in his description that Demangeon shows himself not only a great geographer, but also a master of language. In spite of the many facts and details, the text is fascinating and elevates his book above the standard of the average textbook. Only the third part of his *Isles Brittaniques* dealing with economic life and the empire is somewhat disappointing, because of its intense brevity and its inclusive generalization in portraying the picture of the present industrial and commercial condition and the struggle of Great Britain to maintain her place on the world market.

The value of both books is much increased by the great number of well-selected and well-reproduced pictures, maps, and diagrams; his airplane views of Holland are especially effective.

SAMUEL VAN VALKENBURG.

WILLIAMSON, J. W., B.Sc. *In a Persian Oil Field.* A Study in Scientific and Industrial Development. With a Prefatory Letter by the Rt. Hon. the Earl of Balfour, K.G., O.M., F.R.S. Ernest Benn, Ltd., London, 1927. Price, 7/6.

Mr. Williamson has set out to write an account of the activities of the Anglo-Persian Oil Company, suitable for the general reader, and capable of demonstrating the far-reaching importance of industry carried out on scientific lines.

The book is welcome for several reasons. In the first place, the author has kept faith with the general reader by presenting his facts in language effortlessly comprehensible to any man in an armchair after a day's work. In Chapter 4 a technical subject is treated so that an ordinary reader can follow and appreciate the significance of the study of pressures and levels. Secondly, the writer is brief, and yet says sufficient to stimulate the imagination. "Indeed," so opens a highly suggestive paragraph on page 73, "the gas and the whole of the petroleum taken together, constitute a potential raw material for a stupendous chemical industry, as great as, and possibly greater than, the combined synthetic dye and drug industries which have grown out of the once undervalued coal tar." What are the chances of our seeing Persia contributing directly to the

world's chemical trade? Is there not something arresting in the statements with regard to the transformation of the desert into a centre of industry?

In so far as any account of the Anglo-Persian Oil Company is an advertisement, the book is propagandist. But, it is written in a style so modest that the reader is never conscious of boost. This is largely due to the skill with which the author leaves to the reader the evaluation of the full significance of the facts presented with so keen a sense of balance. Even when dealing with the perfection of the Tembi Pumping Station (page 84) the author refrains from stating that it is the finest in the world, and we appreciate his restraint.

The facts selected by the book are rarely geographical; yet the book supplies supplementary information of value to any geographer interested *In a Persian Oil Field*.

I. J. CURNOW.

SHAW, SIR NAFIER. *Manual of Meteorology.* Volume II, Comparative Meteorology. xxxix and 445 pp.; maps, charts, tables, bibliography, and index. Cambridge University Press, 1928. 7½ x 10½ inches.

This work is the second of an eight-volume series on meteorology, Volumes I and IV of which have already been published.

The first volume, published in 1927, is entitled "Meteorology in History" and treats of the weather as known to the Ancients, of its influence upon the history and culture of Europe, and of the variability of climate in the Mediterranean Region during historical times. It also sketches the evolution of modern methods of obtaining current information about the conditions of the atmosphere and the facility for dealing with the information thus obtained.

The volume under consideration treats the subject of Comparative Meteorology. The introduction and first three chapters are given over to defining and explaining many technical terms as katabatic and tropopause; the influence of sun and space; land, water, and ice; and the composition of the atmosphere. This first portion lays the foundation for a systematic and thoroughgoing treatment of Comparative Meteorology, which is found in the last seven chapters.

In chapters 4, 5, and 6, Dr. Shaw takes up temperature, aqueous vapor, and pressure and winds, showing their world distribution by means of maps, and also including tables showing variations from week to week, month to month, or year to year for certain stations.

In chapter 7, entitled "Changes in General Circulation," climatic cycles or climatic periodicity over long periods of time are considered. This is followed by a chapter on the treatment of weather as a variable from day to day in the various types of storms the world over. Chapter 9 is devoted to the structure of cyclonic depressions, in which the newer theories for cyclones and anticyclones and the development of secondaries are considered.

Almost every conceivable meteorological phenomenon capable of being mapped has been mapped for the entire world. The maps have not been restricted to the mean for the year and for the warmest and coldest months, as is often done, but are for all months. The reason given for so doing is that we seek the course and causes of the transition from one extreme to the other.

The last chapter of the book contains forty-five articles expressing the meteorological conditions between the geopotential levels of 4,000 meters and 8,000 meters elevation at latitude 50°, and their connection with the layers below and above, as indicated by Article 25: "Conditions for penetrative convection. The relation of observed lapse-rate to saturation-adiabatics."

In some respects it is unfortunate that a different type of map was not used to show the distribution of the various meteorological elements. While his polar maps give a very fine picture of polar conditions they are likely to give a disconnected idea of the conditions over a continent divided by the equator.

One other feature in which the book might have been improved is in using the same system for tables as for maps, and not having one in inches and the other in millimeters as was done in the rainfall maps and tables.

While the book apparently was not written to serve as a basic text in an elementary course in meteorology, yet it should be a welcomed addition as a reference, not only in meteorology and general climatology but in the climates of the world as well.

JOHN L. PAGE.

KÜHN, FRANZ. *Argentinien.* 2 vols. Volume I, 256 pp.; indices and bibliography. Volume II, photographs, diagrams, and maps. Ferdinand Hirt, Breslau, 1927. 9½ x 6½ inches.

As the most recent contribution to the ranks of geographic research treating the far southern land, *Argentinien*, by Dr. Franz Kühn, merits careful consideration. As a most lucid and scholarly summary of the physical geography of Argentina, it may well elicit almost unstinted praise. Throughout the volume of text, the various chapters furnish materials attesting to the thorough acquaintanceship with Argentina obtained by the author during more than fifteen years of study in all portions of the country. An exhaustive bibliography, definitive in the field covered, accompanies each section, strengthening further the impression that here may be secured data of undoubted authenticity. To match the excellence of the descriptive matter of Volume I, the second volume offers more than two hundred photographs, corresponding in order of arrangement with the several chapters. The plates, together with the numerous maps pro-

vided, surpass even the better classes of illustrative matter, both from the standpoint of geographic information conveyed and from that of photographic technique.

From a general survey of the principal topographic and morphological features of the country, some of the portions of which suffer somewhat from undue repetition in subsequent chapters, the text progresses to a more lengthy and detailed treatment of the various aspects of Argentine physical geography. Geological summary, orography, hydrography, climate, and phytogeography; under each division the geographer finds well-presented and serviceable summaries, both descriptive and tabular. A time-table of the pre-Tertiary geology of the country and maps of the climatic and vegetation regions, the latter supplemented by a table correlating climate and plant life, among other tables and maps enhance considerably the utility of the volume.

Text, bibliography, index, tables, photographs, diagrams, maps; each item in itself serves to assure Dr. Kühn that his desire to provide an essentially worthwhile summary of the physical geography of Argentina has produced a work of outstanding value.

CHARLES GOOZE.

STEWART, GEORGE. *Alfalfa Growing in the United States and Canada.* xxiii and 517 pp.; maps, charts, tables, bibliography, appendices, and index. The Macmillan Company, New York, 1926. 5 x 7½ inches. $3.50.

When an author includes approximately 650 titles in a bibliography dealing with the subject upon which he writes, it would appear at first that there was little need for an additional treatment of that same subject. Yet, after reading *Alfalfa Growing in the United States and Canada*, one feels grateful to Mr. Stewart for having dug into this formidable mass of references and presented in such an attractive and concise fashion the essential facts concerning this important forage crop.

All phases of alfalfa growing seem to be covered, from the history and varieties of the plant, its physical requirements, its culture, harvesting and marketing, the diseases and pests which attack it, down to the feeding of it to stock. The book, then, is essentially a textbook for schools and colleges of agriculture. Yet, its exceedingly practical nature, its simplicity, clearness, and empiricism, commend the book to the intelligent farmer or rancher as a source of information of immediate interest and value.

To the geographer, the chief interest lies in the distribution of the varieties of alfalfa, the conditions of soil, climate and relief which favor its successful production, and the marketing of both the hay and the seed. Fully half of the book is devoted to these considerations. The author outlines the gradual spread of alfalfa from Persia to Spain, from Spain to southwestern United States, and from there northward and eastward, until every state had been invaded. A very interesting fact is brought out in the tables of Appendix I which shows that 34 states had greater acreages of alfalfa in 1919 than in 1909; but, the percentage of increase in tonnage was less than the percentage of increase in acreage of 27 of these states—only 7 states showed higher yields per acre in that 10-year period.

Many varieties which have been introduced and tried out are discussed, and the physical requirements with respect to temperature, moisture and soil are treated with considerable detail. A map of the United States shows the regions where the four or five most profitable varieties are grown. The growth for seed and the factors involved in the distribution of this seed over the United States suggest the need of instruction in ethics as far as commercial distributors are concerned.

Although much less than the geographer might wish for is said concerning the marketing of alfalfa, since considerable quantities are baled for shipment, and although little is said concerning the extent to which this animal feed is converted into food for human consumption, nevertheless the book is a helpful and commendable summary of the available information on this increasingly important fodder crop.

CLARENCE E. KOEPPE.

STODDARD, LOTHROP. *Re-forging America.* viii and 380 pp.; index. Charles Scribner's Sons, New York, 1927. $3.00.

An anthropological and sociological history of our nation's development, Dr. Stoddard's latest book clearly advocates racial purity as the foundation of national well-being.

In its discussion of the incompatibility of races of contrasted culture and ideals, it calls to mind Madison Grant's *Passing of the Great Race*, with the difference, however, that Dr. Stoddard is careful to emphasize racial difference rather than superiority or inferiority, as the cause of such incompatibility, and so obviates the necessity of refuting the arguments of those who discredit the superiority of the Nordic.

Beginning with Colonial America, essentially of Anglo-Saxon or other North European stock, the course of racial admixture is followed down to the heterogeneity of present day America.

Four great periods in our history seem to be outstanding:

(1) The period prior to the Civil War, in which our racial stock was preëminently North European; the first forging, in which occurred a definition of the finest in American ideals and institutions.

(2) The Civil War and Reconstruction; the schism and the shattering. The Civil War, Stoddard calls the supreme tragedy of American history. From it and the calamity of Reconstruction that followed it, the nation has never recovered.

(3) The period between the Civil War and the Great European War, in which the mass migration of aliens began to change the whole aspect of our economic and social life; a period in which much that was finest in our nation was lost or submerged.

(4) The period following the Great War; the reforging, in which the nation awoke to the dangers of mass immigration and stopped it just in time to avert complete submergence of our national character.

We disposed of the alien problem by the Johnson Act of 1924, "the first step in the reforging, and the second great turning point in our national life." We still have the problem of the negro adequately to solve. The author advocates bi-racialism, with continuance of segregation of the races as a tentative solution.

Dr. Stoddard, although lamenting the unfortunate events in the past, is full of optimism for the future of America, full of a sane, hopeful, and courageous optimism, based on a faith in the national stamina.

The style is argumentative, yet convincing, and impresses one as an excellent appraisal of the American racial situation.

CARLETON P. BARNES.

BRIGHAM, ALBERT PERRY. *The United States of America.* x and 308 pp.; 40 maps, appendix (with 16 tables), bibliographies, and index. Oxford University Press, American Branch, New York, 1927. 5½ x 8¾ inches. $3.00.

One does not have to see the cover or title page of *The United States of America* to know that it is the product of the facile pen of Dr. Brigham; even a cursory reading reveals the authorship to the initiated. One needs only to read this sentence to be convinced (speaking of California): "To work, to retire from working, to win health, to be amused—such are the mingled motives that have changed the population of a great and varied state, have filled its cities and watered its deserts."

This book, as the additional title suggests, is a series of "Studies in Physical, Regional, Industrial, and Human Geography," rather than a complete geography of the United States. It is a book for the student. It is thoroughly impregnated with information. It fails utterly if platitudes are considered a virtue.

The first chapter deals with "The American Domain," a title which suggests the content; in this chapter is given also the historical setting. Then follows a brief regional discussion of the land, based largely upon Fenneman's physiographic divisions. Climate, soil, mineral and forest resources are treated with accuracy and conciseness. The development of manufacturing, transportation and commerce are discussed from a more strictly economic viewpoint; but the human side of geography finds expression again in the chapters on the distribution of population, racial composition, education, traditions and language. "The Statehood Complex" and "National Unity" comprise the final chapters. In the latter, the author has epitomized, from a practical geographer's standpoint, a century and a half of national history.

There is little question but that Dr. Brigham in this, his latest book, has made a genuine contribution, not so much in point of facts as in the interpretation of those facts. Occasionally, however, the reader would welcome a broader interpretation, as on this statement: "There is a 'back-to-the-country' movement." To state that "the whole United States, save on its southern border, has a continental climate" is obviously a slip of the pen, not a misinterpretation of climatological data. One cannot doubt that "America has no conservation problem more serious than that of her forests" when he considers the fact that Michigan, a state with formerly vast timber resources, was forced in 1920 to import lumber to the extent of more than 1,000,000,000 board feet.

In spite of a very few (of the many and otherwise excellent) maps which might not be considered ideal by a cartographer, the value of this book is bound to be appreciated. It will readily find a place as a reference text, as a nucleus for an intensive study of the geography of the United States, or as a source of information for the general reader. The short, well-selected bibliographies at the end of each chapter, and the 16 well-arranged statistical tables of the Appendix will prove to be of valuable assistance to the ambitious student.

CLARENCE E. KOEPPE.

YOUNG, GEORGE. *Egypt.* xxii and 352 pp.; appendices and index. Charles Scribner's Sons, New York, 1927. 8¾ x 5¾ inches. $5.00.

Companion volume to *India*, *Norway*, *Russia*, and *Turkey*, each of which has been reviewed in these columns, *Egypt* well sustains the standard of excellence established by other volumes of the *Modern World* series. Clear and keen in style, logical and thought-provoking in content, the account of a national development among the most interesting and prominent of the world holds the interest of the reader from the brilliant introduction to the well-turned final chapter on the relations of Egypt and the Sudan.

Though not primarily or even secondarily geographic in treatment, the materials of history as set forth offer numerous bases for the study of the evolution of the several geographic problems of modern Egypt. Properly enough, the author concludes his remarks with a discussion of the somewhat enigmatic Sudan; the section presents the essential facts of the situation with concisely comprehensive statements concerning irrigated and irrigable land, present reservoirs and irrigating systems and sites for future dams, and the difficult matter of water-rights.

Qualified by wide experience in conditions of

the Levant, Mr. Young contributes a new and never masked concept of modern Egypt. From the incipience of this Egypt, following the Napoleonic wars, when it broke into the field of European politics, to British occupation and the Kingdom of Egypt, personalities constitute the structure about which the nation has been constructed. Each chapter possesses two titles: Chapter 1 may be designated either as "The Birth of Modern Egypt" or as "Napoleon-Mehemet Ali-Palmerston"; chapter 5—"Financial Reconstruction" or "Cromer"; chapter 10—"The Kingdom of Egypt" or "Fuad-Zaglul." For Egypt of today did not begin with a renascence of national language, legends, or literature, as has been the case in other instances of the rousing of nationalism. Rather did individuals cause the removal of obstructions clogging the springs of Egyptian nationality, by stimulating mass-mind and mass-movement which existed in Egypt more than a century ago.

Impartiality—throughout the chapters does this salient feature reveal itself. Underlying all runs an appreciation of the work of England in the economic life of Egypt as well as all angles of Anglo-Egyptian political activity. And impartiality has led the author to depart from the modern historical procedure of ignoring persons and policies and explaining by economic factors and moral forces, for he believes that with the exception of cotton replacing various products, the economics of Egypt have changed very little since the days of Joseph. Herein lies a source of strong disagreement, inasmuch as only by a wholly restricted and specialized definition of the term "economics" may the statement be justified.

Nevertheless *Egypt* will prove of much value to the geographer, economist, and historian in studies of the modern nation, which only recently has begun to stir itself from its ages of impassive somnolence.

CHARLES GOOZE.

The New England Economic Situation. xi and 260 pp. A. W. Shaw and Company, Chicago, 1927. 6 x 8½ inches.

The New England Economic Situation represents an experiment of the Harvard Business School in the publication of some of the undergraduate themes in the courses of Edwin F. Gay and Allyn A. Young. The book includes nine papers selected by these professors for their content and for their character as good undergraduate work.

While the studies do not attempt to provide a "survey" of New England's economic situation or its major problems, they afford a similarity of pattern around a unifying theme. They include:

I. "Great Fortunes in New England" by Mark Chancellor Stevens.

II. "The Influence of New England Capital in America's Railroad Development" by Guernsey Camp, Jr.

III. "The Influence of Legislative Regulation upon the Relative Growth of National Banks, State Banks, and Trust Companies in New England, 1863–1924," by Edward C. Marget.

IV. "The Wage-Earner and His Savings Deposits" by Abraham J. Saltman.

V. "The Development of Cotton Manufacturing in New England and in the South, 1900–1923" by Morton Pepper.

VI. "The New England Woolen and Worsted Industry" by Alvan G. Smith.

VII. "The New England Boot and Shoe Industry" by William M. Reynolds and Sydney M. Rosenberg.

VIII. "The Position of Massachusetts in the Hosiery and Knit Goods Industry" by David N. Klarfield.

IX. "An Inquiry into the Causes of the Decline of the Automobile Industry in New England" by Carrol J. Hoffman.

Thus, the studies range from the eighteenth century when New England led other sections of the United States in building up the "great fortunes" of the country and from the period when New England capital took a prominent part in the railroad building of the West to the present time when New England industries are finding increasing difficulty in holding their own in the program of national industrial expansion. The two papers on banking challenge some current opinions and point the way for further research. The studies of four of New England's major industries clearly set forth the trends not only in this part of the country, but in the rapid rise in other producing regions as well, along with some of the chief problems of readjustment. The last paper analyzes the failure of the automobile industry in New England, an industry begun here but forced to move westward.

The students have not attempted to treat these topics exhaustively; they are on the whole well done and stand as a challenge to other students in the same field and to those in other subjects, especially of a graduate nature. It is hoped that this experiment will be continued, and that it will give rise to other useful volumes.

CLARENCE F. JONES.

NOURSE, EDWIN G. *The Legal Status of Agricultural Coöperation.* xix and 555 pp.; table of contents, appendices, and index. The Macmillan Company, New York, 1927. $3.00.

This book deals with the legal aspects of agricultural coöperation as seen through the eye of an able economist. While it makes a valuable addition to that already famous series of the Institute of Economics, it has little to offer to the average geographer. It may be read advantageously by the agricultural and commercial geographer, who will get from it a better understanding of the commercial, legislative, and judicial evolution of agricultural coöperation in the United States dur-

ing the past three-quarters of a century. But the book was written for economists and lawyers, not for geographers—a fact that becomes evident ere many pages have been perused.

The author skillfully unfolds before the reader's eyes the story of agricultural coöperation from its rather crude beginnings in the then isolated trans-Appalachia to its present high development in the raisin, prune, and citrus fruit-growing districts of California.

The first sixteen chapters (pages 1 to 422) present an historical and analytical treatment of the farmers' efforts to attain a satisfactory status for the coöperative type of organization. The author's interpretation is supplemented throughout by the views of others. This adds considerable enthusiasm and interest to the book.

The seventeenth and final chapter (pages 423–439) is the author's own; it is his appraisal of "the soundness and desirability of agricultural coöperative institutions in their present legal status." Here he draws the following four conclusions, each of which he discusses adequately:

1. "It is well that coöperation, even of the forceful modern pattern, has been accepted as a going institution of present-day business.
2. "It is both inept and unnecessary for cooperative institutions to be developed as class legislation applicable only to agriculture.
3. "Even large and powerful coöperative organization does not constitute a public menace, owing to the presence of natural and institutional checks upon the abuse of power.
4. "No formula for the regulation of cooperative activities can be laid down in definite and final terms."

And finally there are thirteen appendices for those students who wish detailed information about certain laws, bills, acts, agreements, and contracts in force in different parts of the country.

The book is well written, scholarly, and scientific—precisely what the reader would expect from the author—a specialist and an authority in agricultural economics.

LANGDON WHITE.

HIBBARD, BENJAMIN H. *A History of the Public Land Policies.* xix and 591 pp.; preface, table of contents, tables, maps and charts, index, and bibliography. The Macmillan Company, New York, 1924. $4.50.

In his *History of the Public Land Policies,* Professor Hibbard has summarized in a single volume the story of the government's acquisition and distribution of the public domain. This book, one of the Land Economics Series, edited by Richard T. Ely, will make a worthy addition to the library of the economic geographer.

The first five chapters carry the story of the Public Domain to 1820; the next eleven chapters from 1820 to 1862, and the remaining ones to the present.

A wealth of material is crammed into the 591 pages, and the many footnotes attest the great amount of research involved in the preparation of the book. To condense so much material is no small task; in this case it has been done well, though at the expense of a vivacity of style which otherwise would have characterized the book. Support of this statement may be found in a perusal of the last chapter.

The first thirteen chapters contain a few nuggets of historical geography, but the following ones contain a lode of geographic material:

XIV. Swamp-Land Grants.
XVII. The Homestead or Free Land for Settlers.
XVIII. The Modifications and Operation of the Homestead Act.
XIX. The Timber Culture Act.
XX. The Desert Land Acts.
XXI. Disposal of Timber and Timber Lands.
XXII. The Period of Conservation 1900 to 1920.
XXIII. Grazing the Public Domain.
XXIV. Classification of the Public Lands.
XXV. Mineral Lands.
XXVI. Reserved Lands.
XXVII. Effects of the Land Policies on Agriculture.
XXVIII. The Public Land Policies Reviewed and Criticized.

Undoubtedly the best chapter in the book is the last—a review and criticism of the government land policies. This is the only chapter in which the reader really *feels* the personality and individuality of the author. In the others only occasionally does Professor Hibbard express personal opinions. In this chapter, however, he not only criticizes *destructively* (something all of us can do) but what is far more significant and valuable, he criticizes *constructively* (something most of us cannot do). So ably does he perform this task that the reviewer feels he has made a real contribution to knowledge.

Points of geographic interest chosen at random are the discussion of the weakness of the Homestead Act. This act never was adapted to any parts of the country for which it was not designed. It failed completely in its attempt to cross the Great Plains; it also broke down in the forested regions, though in this case to the welfare of the settlers. It was successful east of the hundredth meridian.

The Timber Culture Act also was a sad mistake. It resembled the Homestead Law in that it was made for a given type of land and applied to a totally different type in a very short time; it was framed when government land still remained immediately west of the Missouri River and in Iowa and southwestern Minnesota. But by the time it got under way, it was pertaining to the semi-arid lands to the west where it was both impos-

sible and undesirable to grow forests with trees the size wanted by the government.

One of the most unfortunate failures of the government was its handling of the timber supply. Moreover, every individual in the country is beginning to realize it.

Professor Hibbard justly stresses the fact that we used our resources without any appreciation whatsoever of their ultimate limitation.

The work of the Forest Service is lauded, the author looking upon it as the one bright spot in an otherwise very black sky.

From a national standpoint there is crying need of a general conservation policy . . . for the food, clothing, and shelter questions all are involved. It is not yet too late! We yet have time to execute a scientific land policy over what we still have and over what we may purchase cheaply.

The examples cited above enable one to get the spirit of the book. On the whole the work is carefully done, though inaccuracies do occur, both in fact and in conclusion. But inasmuch as they lie not in the realm of geography, but rather in that of history and political science, the reviewer will not discuss them.

While the book is crammed with facts, it makes interesting reading. For him who is not particularly interested in our public land policy or who wants his information quickly, the author has appended to the longer chapters a brief and excellent summary. Effective and well-made maps and charts emphasize the textual material of several chapters.

LANGDON WHITE.

ATLASES AND MAPS

HOWELL, J. PRYSE. *An Agricultural Atlas of England and Wales.* 22 bound pages of large-size dot maps of distribution of agricultural lands and products, and four additional loose maps—orographical, geological, market towns, and rainfall. Published by the Ordnance Survey, Southampton, 1925. Price, 10/ net.

This atlas is indispensable to the agricultural geographer or economist, to any geographer, or any student of England and her resources. It is an exceptionally valuable contribution, a graphic epitome of the status of agriculture in England and Wales at the present time.

CAMPBELL, MARIUS R. *Coalfields of the United States.* Proceedings of the International Conference on Bituminous Coal, Carnegie Institute of Technology, Pittsburgh, 1926. Price, 50 cents, from M. R. Campbell, 2220 Twentieth Street, Washington, D. C.

A superior map that should be available in every library that pretends to be up to date in economic and geographic matters, and in the possession of every student. It is a clear, authoritative presentation of the distribution, extent, and character of the coal reserves of the United States.

Geological and Relief Maps of Tennessee. State Geological Survey of Tennessee in coöperation with the United States Geological Survey.

These two large size maps of the geology and relief of Tennessee are fine examples of the basic work being done in the development of our resources and of the map maker's art. They constitute a valuable addition to the rich regional map literature of this country and should be on file for reference and use in every library. To the state of Tennessee and its citizens the maps are invaluable.

W. ELMER EKBLAW.

BOOK NOTICES

BLAKESLEE, GEORGE H. *The Recent Foreign Policy of the United States.* 361 pp.; index. Abingdon Press, New York, 1925. 5½ x 7½ inches. $2.00.

A lucid discussion of American international relations with Europe, Latin America, and the Far East, by one who speaks with authority. It should go far toward promoting a clearer and more helpful understanding of the great problems of foreign relationships.

PEATTIE, DONALD CULROSS. *Cargoes and Harvests.* 306 pp.; index; bibliography. D. Appleton & Co., New York, 1926. 5½ x 8½ inches.

A history of the use of certain vegetable commodities and a look into the future as regards world food supply under the pressure of increased population.

EASTMAN, E. R. *These Changing Times.* 245 pp.; index; illustrations. The Macmillan Co., New York, 1927. 5½ x 7½ inches.

The progress of agriculture during the last twenty-five years; transportation, farm machinery, coöperative marketing, legislation, taxation, education, and social relationships.

FOSTER, WILLIAM TRUFANT and CATCHINGS, WADDELL. *The Road to Plenty.* 231 pp. Houghton, Mifflin Co., New York, 1928. 5½ x 7½ inches. $2.00.

The economics of prosperity. A story of a smoking room conversation in which a discussion of economic problems leads to enlightenment. A story that will disperse some prevalent but unsound notions regarding the basis of prosperity.

LUBIN, ISADOR and EVERRETT, HELEN. *The British Coal Dilemma.* xii and 364 pp.; index. The Macmillan Co., New York, 1927. 5½ x 7½ inches. $2.50.

Results of an economic investigation of the conditions of the British coal industry with respect to capital, labor, mining technique, and market.

HAUGH, WALTER. *Fire as an Agent in Human Culture.* 257 pp.; index; illustrations. Bulletin 139, Smithsonian Institution. Government Printing Office, Washington, 1926.

An exhaustive study of fire in the culture of primitive peoples, by the head Curator of Anthropology of the United States National Museum. A great number of excellent pictures illustrate the work.

ADAMI, COLONELLEO VITTORIO. *National Frontiers in Relation to International Law.* viii and 121 pp.; bibliography. Oxford University Press, London, 1927. 7 x 9½ inches.

A discussion of national boundaries, natural and artificial, and a history of their part in international relations.

THOMAS, LEWIS F. *The Localization of Business Activities in Metropolitan St. Louis.* xii and 108 pp.; bibliography; maps and illustrations. Washington University, St. Louis, 1927.

A well organized transportation, industrial, and commercial survey of an urban region. A study in urban economic geography.

India as a Producer and Exporter of Wheat. 393 pp.; bibliographical notes; many graphs, charts, tables, and maps. Food Research Institute, Stanford University, Calif. Vol. III of *Wheat Studies,* July, 1927.

A comprehensive geographic study of Indian wheat production and exportation, dealing with physical factors, technique of production, market conditions, and genetics, with a historical review and a prediction of future developments.

MILONE, FERDINANDO. *Il Porto di Napoli.* 130 pp.; tables. Citta di Castello. Societa Anonima Topografica "Leonardo da Vinci," 1927.

A commercial study of the port of Naples. Many interesting tables and statistics.

MUIR, RAMSAY; PHILIP, GEORGE; and MCELROY, R. B. *Putnam's Historical Atlas.* xxxii and 62 pp. of text; 96 plates, containing 229 colored maps and diagrams; index. G. P. Putnam's Sons, New York, 1927. 6th edition. 9½ x 11½ inches.

A work of great merit. An economic history of the United States by Robert B. McElroy, occupies the first section of 15 pages and is illustrated with 9 maps. The text of 62 pages deals with the historical development and expansion of Europe, the British Empire and the United States, and is illustrated with 40 maps and plans. Two hundred twenty-nine beautifully colored historical maps showing the course of settlement and population growth, and the rearrangement of political frontiers. The entire atlas will prove a most helpful compendium of information.

HARDENBURG, E. V. *Bean Culture.* xiv and 231 pp.; index; illustrations. The Macmillan Co., New York, 1927. 5½ x 7½ inches. $3.00.

A treatise on the technique of bean culture, with a history of the bean as a food crop, a discussion of marketing, and varieties of beans. A valuable contribution to agronomy.

VOORHEES, EDWARD B. *Fertilizers.* xix and 302 pp.; index. The Macmillan Co., New York, 1926. 5½ x 7½ inches. $2.50.

A technical discussion of fertilizers, their chemistry and application.

ISE, JOHN. *The United States Oil Policy.* xi and 526 pp.; appendix; index; tables; illustrations. Yale University Press, 1926. 7 x 10½ inches. $7.50.

A comprehensive history of oil developments and national policy in relation thereto.

LOCKE, AUGUSTUS. *Leached Outcrops as Guides to Copper Ore.* vii and 166 pp.; glossary; index; 19 plates of illustrations. Williams and Wilkins Co., Baltimore, 1926. 6 x 9 inches. $5.00.

A technical discussion of the use of leached outcrop for the prediction of hidden sulphide copper ore.

TWENHOFEL, W. H. *Treatise on Sedimentation.* xxv and 641 pp.; index; tables; illustrations. Williams and Wilkins Co., Baltimore, 1926. 6 x 9 inches. $7.50.

An excellent comprehensive text on the mechanics of sedimentation, the structure, texture and colors of sediments and the environments of sedimentation.

SALMON, BRAINERD P. *Glimpses of Greece.* 112 pp.; illustrations. Hellenic Information Bureau, Washington, D. C., and Anglo-Hellenic League, London. In paper, 85 cents; cloth, $1.60 postpaid.

A description of modern Greece with more than one hundred beautiful sepia illustrations.

BOWIE, WILLIAM. *Isostasy.* viii and 274 pp.; maps; illustrations; diagrams; index. E. P. Dutton and Co., New York, 1927. 6 x 8½ inches. $5.00.

A clear discussion of subject difficult to present satisfactorily comprises most of this volume. The whole theory of isostasy, and its relation to tectonic movement and geologic structure, is set forth for every one to read and understand.

CARLETON P. BARNES.

ANNOUNCEMENT

THE series of articles, *Agricultural Regions of the World*, is continued in this issue with the second instalment of *Agricultural Regions of South America*, by Dr. Clarence F. Jones of Clark University, presenting the latest and most authentic data available on South American agriculture and including a large map in colors indispensable to every student of South America. The sixth instalment of *Agricultural Regions of North America* by Dr. O. E. Baker of the United States Bureau of Agricultural Economics will appear in a later issue.

Agricultural Regions of Africa, by Homer L. Shantz of the University of Illinois and president-elect of the University of Arizona; of *Australia*, by Griffith Taylor of the University of Sidney, one of the foremost geographers of the world; and *of Asia*, by Olof Jonasson of the University of Commerce of Stockholm will follow in later issues to complete the finest geographic discussion of the world's agriculture thus far published.

To obtain the complete series of these extremely valuable articles, which present for the first time on such a comprehensive and accurate basis the significant divisions of the world's most important industry, it will be necessary to subscribe at once for ECONOMIC GEOGRAPHY, and date back to the October, 1926, issue.

In addition to this series of articles on agriculture, other series are being initiated; every issue will also contain four or five other articles dealing with urban and regional geography, with problems of land utilization, with programs of development of resources, with commerce, with transportation, with health, and with the hundred and one other subjects that are of present geographic interest, all by the most competent and best informed authorities in their respective fields. ECONOMIC GEOGRAPHY is indispensable to the intelligent citizen.

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